

VOLUME XXXII

NUMBER 3

JOURNAL
OF THE
ARNOLD ARBORETUM
HARVARD UNIVERSITY

EDITORIAL BOARD

C. E. KOBUSKI, *Editor*

I. M. JOHNSTON

I. W. BAILEY

KARL SAX

JULY, 1951



PUBLISHED BY
THE ARNOLD ARBORETUM OF HARVARD UNIVERSITY
JAMAICA PLAIN, MASS.

1951

been surprising to discover, therefore, that the stamens and other structures inside the corollas of *Onosma* show wide differences between species and, though previously totally ignored, provide numbers of precise, very usable characters for distinguishing species. Their usefulness is illustrated in the subjoined account of the Sino-Indian species. Among most of these species an examination of the corolla is all that is needed for precise identification.

The useful characters found on the inner surface of the corolla are those involving the distribution of any hairs that may be present, the height above the corolla-base and nature of the filament-attachment, and the size, form, and indument of the suprabasal appendage known as the nectary. The stamens also show considerable diversity from species to species. The filaments differ in length, shape, and nature of attachment, in presence or absence of pubescence, and, when developed, in size and shape of their decurrent base. The anthers are also diverse. In some species they are free from one another, in others they are coherent at the base only, and in still others they are firmly joined laterally as well as basally and form a tube. They may be completely included in the corolla or protrude from the mouth to various degrees. Between different species they differ also in length, in height of attachment to filament, in nature of the connective, in shape of base, in size and shape and margin (presence or absence of denticulations) of the sterile tip. In some species tendencies towards zygomorphy are evident. This is very clear in *O. multiramosum*. In that species the corolla is slightly bilabiate, and the anther-tube is unilaterally curved. In species such as *O. Farrerii*, *O. Thomsonii*, and relatives of *O. lycopsioides*, and I suspect in less degree in other species also, asymmetry is revealed by differences in the attachment among the five stamens within the flower. In these two filaments are transversely, two are obliquely attached, and the fifth, odd filament is vertically attached to the corolla, all at the same distance above the corolla-base. The style is generally uniform. In a few species, however, it is characteristically hairy below the middle.

For use in the present study I have had the privilege of receiving on loan specimens from the Gray Herbarium (G), New York Botanical Garden (NY), United States National Herbarium (US), Missouri Botanical Garden (Missouri), University of California at Berkeley (UC), Royal Botanic Garden, Kew (K), Royal Botanic Garden, Edinburgh (Ed), and Forest Research Institute, Dehra Dun (DD). The loans from Edinburgh and Dehra Dun have been of special value and usefulness because of the very large number and high critical value of the specimens they contained.

KEY TO THE SPECIES

Anthers united laterally as well as basally, forming a tube.

Anthers included in the corolla or with only tips extruded.

Filaments and style hairy (hairs 0.3–0.7 mm. long); stems arising singly from a biennial root, bearing a panicle of cymes; southwestern China.

- Plant with distinctly hirsute stems and leaves; middle cauline leaves 1-2 cm. broad; reduced uppermost leaves very abruptly expanded at base and usually somewhat sagittate and amplexicaul.....1. *O. paniculatum*.
- Plant with scanty short inconspicuous bristles on stem and leaves; cauline leaves 3-4 cm. broad; reduced uppermost leaves triangular-ovate, scarcely if at all amplexicaul.....2. *O. oblongifolium*.
- Filaments and style glabrous or (in no. 8) at most microscopically puberulent; stems usually several from a perennial root.
- Nectary glabrous; western India.
- Filaments short (2-2.5 mm. long), base of anther about opposite base of filament.....3. *O. chitralicum*.
- Filament longer (5-10 mm. long), base of anther 2-6 mm. above base of filament.
- Plant with a strong perennial root; stems 1-7.5 dm. tall; basal leaves 10-40 cm. long, 5-15 mm. broad; Kumaon to Chitral..4. *O. hispidum*.
- Plant with biennial or short-lived root; stems 1-3 dm. tall; basal leaves 4-10 cm. long; Chitral to Baluchistan.
- Bracts of inflorescence with slender decidedly attenuate tips; corolla 30-32 mm. long; filaments 9-10 mm. long.....5. *O. khyberianum*.
- Bracts of inflorescence acute, not noticeably slender-attenuate; corolla 22-30 mm. long; filaments 6-9 mm.
- Middle stem-leaves 3-7 mm. broad, hairs on upper surface more or less antrorsely appressed; corolla 22-25 mm. long; Baluchistan.....6. *O. barbigerum*.
- Middle stem-leaves 8-15 mm. broad, hairs on upper surface erect; corolla 25-30 mm. long.....7. *O. Griffithii*.
- Nectary villose.
- Filaments arising at or near middle of corolla, decurrent base linear, about as high as broad, farinose-puberulent; corolla 14 mm. long, very minutely puberulent outside; Tibet.....8. *O. Waltoni*.
- Filaments arising distinctly below the middle of corolla, the decurrent base oblong or lanceolate, broader than high or higher than broad, not farinose-puberulent.
- Cymes coarse, 4-5 cm. broad; filaments borne 6.5 mm. above corolla-base; anthers 10 mm. long; corolla 19.5 mm. long, evidently strigose outside; calyx at anthesis 12-17 mm. long; n. w. Yunnan.....9. *O. Wardii*.
- Cymes 1-4 cm. broad; filaments borne 3-4.5 mm. above corolla-base; anthers 5-8 mm. long; corolla 10-18 mm. long.
- Stems 3-10 dm. long, erect, arising singly; cymes borne terminal on main stem or on numerous slender peduncles from the upper axils, hence displayed in an elongate panicle; middle cauline leaves 4-12 cm. long; corolla 13-18 mm. long, evidently strigose outside; calyx at anthesis 9-12 mm. long; s. w. China.....10. *O. confertum*.
- Stems 1-3 dm. long, erect to decumbent, usually several rising together, producing major terminal cymes and later smaller

- cymes in many of the leaf axils, the aggregate inflorescence not distinctly paniculate; middle cauline leaves 2-5 cm. long; corolla 10-15 mm. long, outside puberulent and on and below the lobes, also hispidulous; calyx at anthesis 5-7 mm. long; Tibet.....19. *O. Waddellii*.
- Anthers more than half exserted, commonly almost completely so.
Base of filaments and adjacent corolla-tube villose.
- Leaves obviously broadest at or above middle, gradually attenuate towards the very narrow acute or even subpetiolate base; plant with very slender loosely branching stems; China.....
.....11. *O. sinicum*.
- Leaves broadest at or near base.
Plant robust, flowering stems coarse, 3-5 mm. thick; filaments subulate, broadest at the very base; Burma....12. *O. burmanicum*.
- Plant with clusters of slender erect simple flowering stems 2 mm. or less thick; filaments broadest (0.5-0.7 mm.) a short distance (0.5-1 mm.) above base, hence perceptibly narrowed just above the attachment; n. w. Himalaya....13. *O. hypoleucum*.
- Base of filament and adjacent corolla-tube not villose.
Stems coarse, usually 5-12 mm. thick near base, rising singly from a stout biennial root, more than 6 dm. tall, usually reaching a meter or more; China.
- Anthers becoming completely exserted; corolla-throat 4.5-5 mm. thick, inside hairy below the lobes; calyx and pedicels strigose with stout short hairs less than 1 mm. long; anthers 5.5-6.5 mm. long; sterile tip 0.5-1 mm. long.....14. *O. exsertum*.
- Anthers only half exserted; corolla-throat 8-10 mm. thick, glabrous inside; calyx and pedicels villose-hispid, the hairs mostly spreading and 1-3 mm. long; anthers 7-8 mm. long, sterile tip 1.5-2 mm. long.....15. *O. fistulosum*.
- Stems more slender and shorter, usually several rising together from the root.
Tip of anthers and tip of flower-bud becoming curved to one side; China.....16. *O. multiramum*.
- Tip of anthers and tip of flower-bud straight or nearly so.
Base of filament and adjacent portions of corolla-tube papillate and glanduliferous; base of filament not decurrent. China..
.....17. *O. adenopus*.
- Base of filament and adjacent corolla neither papillate nor glanduliferous (decurrent base of filament sometimes papillate in no. 19).
Style hairy below middle; corolla-throat abundantly hairy inside; anthers 9-10.5 mm. long, sterile tip 2.5-3 mm. long..
.....18. *O. album*.
- Style glabrous; corolla-throat glabrous or with only inconspicuous lines of hairs below the lobes; anthers 4-8.5 mm. long, sterile tip 0.3-2 mm. long.
Filaments with a prolonged elevated decurrent base 2.5-3 mm. long; corolla-throat 5-8 mm. broad, inside frequently bearing a line of hairs below each lobe; plant not developing a shrubby caudex; Tibet.....
.....19. *O. Waddellii*.

Filaments not decurrent, with transverse arcuate attachment; corolla-throat narrow, 3-5 mm. thick, glabrous inside; base of stems persisting and forming a loose fruticulose caudex.

Middle cauline leaves oblanceolate; corolla blue, outer surface with antrorse hairs; China.....20. *O. Farrerii*.

Middle cauline leaves lanceolate; corolla white, outer surface with mostly retrorse hairs; n. w. Himalayas.....
.....21. *O. Thomsoni*.

Anthers united only at the very base.

Calyx divided into narrow, very elongate, linear or linear-lanceolate lobes; lobes many times longer than broad.

Corolla shorter than calyx-lobes or at most equaling them; bracts lanceolate, with excessively prolonged tips; lower leaf-face evidently veined, clothed with a pallid indument of abundant minute hairs; western Himalaya (Kumaon).....22. *O. bracteatum*.

Corolla evidently surpassing the calyx-lobes; bracts lanceolate or subulate, tips acute.

Filaments attached at or above middle of corolla; corolla 16-33 mm. long.

Corolla blue or red, outer surface with abundant evident appressed hairs; nectary villose; anthers 5.5-9 mm. long, sterile tip ca. 0.5 mm. long; plant 1-3 dm. tall, perennial; eastern Himalaya and Tibet.....23. *O. Hookeri*.

Corolla yellow, outer surface glabrous or nearly so; nectary glabrous; anthers 9-12 mm. long, sterile tip 1-1.5 mm. long; plant 2.5-10 dm. tall, biennial; Afghanistan, Baluchistan and adjacent India.....24. *O. dichroanthum*.

Filaments attached distinctly below the middle of the corolla.

Filaments thickened and conspicuously villose just above the base, 5-6 mm. long, attached 1.7-2.5 mm. above corolla-base; corolla barrel-shaped, red, broadest near middle, 11-13 mm. long; anthers 4-4.5 mm. long; Kumaon.....25. *O. pyramidale*.

Filaments not thickened nor hairy above the base; corolla gradually expanding from the base, broadest at or near the level of the lobes, pink to purple.

Corolla twice as long as the calyx-lobes, 16-17 mm. long; filaments 4-5 mm. long, attached 5-6 mm. above base of corolla; anthers 7-7.5 mm. long; western China.....
.....26. *O. mertensioides*.

Corolla about once and a half the length of calyx-lobes, 7-17 mm. long.

Plant 1-3 dm. tall; stems simple or producing a few coarse cymes in the upper axils; corolla minutely hispidulous or villulose or nearly glabrous outside; nectary sparingly hairy or nearly glabrous; filaments 1.5-6.5 mm. long, attached 3-8 mm. above corolla-base; anthers 2.5-6.5 mm. long; Afghanistan, Baluchistan and adjacent India.....
.....27. *O. limitaneum*.

Plant 5-15 dm. tall; stems with very numerous floriferous branches; corolla evidently and abundantly appressed villose outside; nectary densely villose; s. w. China.

- Stems very bristly, tawny hispid; style and decurrent base of filaments glabrous; filaments 2–2.5 mm. long, attached 2–2.5 mm. above corolla-base; anthers 4–4.5 mm. long. 28. *O. cingulatum*.
- Stems sparingly bristly, cinereous; style below middle and decurrent base of filaments sparingly hairy; filaments 4 mm. long, attached 3.5 mm. above corolla-base; anthers 5.5 mm. long. 29. *O. Tsiangii*.
- Calyx with a broad shallow tube and cuneate or narrowly triangular lobes; lobes gradually narrowed from the broad base, 1.5–3 times longer than broad.
- Corolla 14–18 mm. long.
- Corolla above middle minutely verruculose; Nepal. 30. *O. verruculosum*.
- Corolla not verruculose, firmer; Assam and s. w. China.
- Leaves mostly with stiffish appressed hairs 1–2 mm. long; plant drying light in color. 31. *O. Borii*.
- Leaves with more slender spreading hairs 2–3 mm. long; plant noticeably darkening in drying.
- Cauline leaves with obtuse or acute base, moderately hairy. 32. *O. lycopsioides*.
- Cauline leaves abruptly rounded at very base, abundantly hairy. 33. *O. microstoma*.
- Corolla 9–12 mm. long.
- Filaments 5 mm. long; corolla yellow; Yunnan. . . 34. *O. dumetorum*.
- Filaments 1–2.5 mm. long; corolla blue or purple.
- Root stout, strong, perennial, 5–15 mm. thick. 35. *O. emodi*.
- Root weak, slender, annual or at most biennial, 0.5–2 mm. thick.
- Corolla 1–1.5 times longer than broad, broadly ovoid, with puffed-out ribs conspicuously protruding between the calyx-lobes. 36. *O. Wallichianum*.
- Corolla twice longer than broad, barrel-shaped, ribs weakly protruding between the calyx-lobes.
- Hairs of foliage single, none stellately arranged. 37. *O. bicolor*.
- Hairs stellately arranged on leaf, at least on the upper surface. 38. *O. egregium*.
1. *Onosma paniculatum* Bureau & Franchet, Jour. de Bot. 5: 104 (1891); Handel-Mazzetti, Symb. Sinicae 72: 816 (1936).—Type from the vicinity of Tatsienlu, *Bouvalot & d'Orleans*.
- Onosma paniculatum* var. *hirsutistylum* Lingelsh. & Borza, Repert. Sp. Nov. 13: 389 (1914).—Type from mountain slope between Yo-tsai and Kwang-dung on road from Yunnan to Tsuyung, *Limpricht 966*.
- Plant biennial or rarely perennial, darkening in drying, with a stout dye-stained taproot; stems single, 3–12 dm. tall, 5–10 mm. thick towards the base, sparingly hispid (hairs spreading, 1–4 mm. long, bulbous-based) and abundantly and usually retrorsely hispidulous or villulose (hairs 0.1–0.5 mm. long), producing pedunculate cymes from the upper axils but otherwise unbranched; leaves appressed hispid (hairs 2–4 mm. long,

arising from discoid bases) and sparingly villulose or hispidulose on the upper surface, lower surface abundantly hispidulous or villulous and sparingly and inconspicuously hispid; lower leaves 10–20 cm. long, 1–3 cm. broad, oblanceolate with a winged petiole; cauline leaves gradually reduced up the stem, lanceolate, 1–2 cm. broad, those above the middle sessile, broadening above the base and becoming somewhat sagittate and even somewhat amplexicaul; cymes mostly simple, very numerous, terminal on the main stem and arising on leafless peduncles 3–10 cm. long from many of its upper axils, hence paniculately displayed, at anthesis 2–4 mm. broad, in fruit elongating and unilaterally racemose, 5–10 cm. long; larger bracts more or less sagittate, smaller bracts lanceolate or subulate; calyx hispid and strigulose, 5–14 mm. long, not much accrescent in fruit; pedicels slender, straight, 5–20 mm. long; corolla red or pinkish red changing to violet and blue, 12–17 mm. long, from a base 2.5–3.5 mm. thick gradually expanding upwards, 8–10 mm. thick at level of sinus, outside abundantly antrorse-strigulose, inside strigulose on throat below each corolla-lobe; lobes broader than long, margin revolute; anthers included or with only tips exerted, coherent basally and laterally to form a tube, 6–8 mm. long, base borne 6–8 mm. below level of corolla-sinus, filament-attachment 1–1.7 mm. above base; filaments 3–4.5 mm. long, evidently villulose, from a decurrent base 1 mm. long and 0.4–0.8 mm. wide gradually narrowed upwardly, arising 3–4.5 mm. above corolla base; nectary about 0.5 mm. high, lobed, densely villose; style 15–18 mm. long, lower two-thirds appressed hairy; nutlets 2 mm. long, dull, verrucose.

Southwestern China, from central Sikang south in the highlands to Yunnan and adjacent Kweichow; also in Bhutan.

SIKANG: betw. Yenyuan and Hunka, 2800 m., *Schneider 1481* (E); Huei-li Hsein, grassy place on mountain slope, 2800 m., plant 3 ft. tall, fl. pinkish red, *T. T. Yü 1525* (G); near Tatsienlu, *Bowvalot & d'Orleans* (G, frag. of type).

YUNNAN: Mengtze, 6500–7000 ft., fl. red with bluish tinge, *Henry 9334A* (NY, Ed); east base of Tali Range, open stony pasture land, plant 2–4 ft. tall, fl. deep rose-purple, 6700–8000 ft., *Forrest 4472* (Ed); in monte Lautsching in dist. Yunnan-fu, in rupibus calcar., fl. rubescentibus, alt. 2200 m., *O. Schoch 225* (US); Ahsi, northwest Likiang Snow Range, open hillsides, pl. 3 ft., fl. rose-purple and rose-blue, *R. C. Ching 20781A* (G); Likiang, 2950–3100 m., fl. red becoming blue, *Handel-Mazzetti 4164* (G); Likiang plain, lat. 27°20', plant 2–4 ft., fl. rose changing to blue, dry open situations, 8500 ft., *Forrest 6085* (Ed); east flank of Likiang Range, lat. 27°12', dry stony open situations in pine forest, 9000–10500 ft., plant 1.5–2.5 ft. tall, fl. at first rose-purple then blue, *Forrest 2447* (Ed); Chin Hai Tze, east slope Likiang Snow Range, alpine meadow, 11000 ft., fl. red and blue, *Rock 4441* (G, US, Ed); Tungchwan, fl. pink becoming blue, 2600 m., *Maire* (G, US, Ed); north flank Haba Snow Range, dry open pine forest, plant 2–3 ft. tall, fl. flushed purple and blue-purple, *K. M. Feng 1319* (G); inter Lanticho et Poloti, reg. Yungning-Yingpeh, fl. obscure purp., June 29, 1914, *Schneider 1682* (US).

KWEICHOW: Weining, open hillside, fl. red, *Y. Tsiang 9108* (NY).

BHUTAN: Lingtsi to Kurmed, sandy soil under *Pinus longifolia*, 6000 ft., fl. red and blue, July 24, 1915, *R. E. Cooper 4176* (Ed); Re-Teng to Tsaza-La, 8175-9125 ft., July 2, 1938, *B. J. Gould 742* (K, DD).

TIBET: upper Chumbi Valley, 12000 ft., Sept. 1938, *B. J. Gould 1577* (K).

This is the most widely distributed and the most frequently collected of the Chinese species of the genus. It is very distinct, readily recognizable and has its closest relative in *O. oblongifolium*. In producing a single tall flowering stem from a stout biennial root, it has a growth habit shared by several other species in southwestern China, namely *O. oblongifolium*, *O. album*, *O. exsertum*, and *O. fistulosum*. *Onosma confertum* has a somewhat similar appearance but its root can be persistent and may produce more than a single stem each season. A very unusual feature of our plant is its sagittate uppermost leaves. These are a very useful aid in recognizing it.

2. *Onosma oblongifolium* W. W. Smith & Jeff. Notes R. Bot. Gard. Edinburgh 9: 113 (1916). — Type from bend of Yangtse, lat. 27° 45', Yunnan, *Forrest 11198*.

Plant biennial, producing a single erect stem 7.5 dm. tall; stem 7 mm. thick towards base, above middle producing leafless floriferous branchlets 5-15 cm. long, abundantly hispidulous, the minute hairs retrorse 0.5-1 mm. long mostly with a thickened base; leaves green, scabrous, ample, gradually reduced up the stem, minutely hispidulous, on upper surface also with scattered short bristles arising from discoid bases; basal leaves unknown; middle cauline leaves sessile, narrowly oblong, 12-14 cm. long, 30-38 mm. broad, broadest at or just above the middle, base abruptly contracted, obtuse, apex obtusish; upper cauline leaves oblong-lanceolate to triangular-ovate, broadest just above the truncate or abruptly rounded and subamplexicaul base; cymes numerous, terminal and on peduncles arising from many of the uppermost axils, hence paniculately displayed, in fruit unilaterally racemose, 5-7 cm. long; bracts ovate to acute, broadly attached; calyx 10-12 mm. long, not much accrescent in fruit; hispidulous and sparingly bristly below middle; pedicels slender, 5-13 mm. long; corolla "bluish rose," 13-15 mm. long, from a base 2.5 mm. thick gradually expanded, becoming 8.5 mm. thick just below the sinus, outside above middle abundantly and antrorsely appressed villulose, throat inside strigose along a line below each corolla-lobe, lobes broader than long, margin revolute; anthers 7-8 mm. long, coherent basally and laterally to form a tube, base borne 6-8 mm. below level of corolla-sinus, attached to filament 1.5 mm. above base; filaments abundantly short villulose, from a decurrent base 1 mm. long and 0.5 mm. broad gradually narrowed upward, 4.5-5 mm. long, arising 2.5-3 mm. above corolla-base; nectary narrow, lobed, less than 0.5 mm. broad, villose; style 15-16 mm. long, appressed hairy; nutlets brown, opaque, 2.5-3 mm. long tuberculate obscurely pitted.

CHINA (northern Yunnan): mountains in the north of the Yangtse bend, 10000 ft., lat. 27° 45', open stony pasture, plant 2-2.5 ft. tall, fl. bluish rose, *Forrest 11198* (TYPE, Ed).

A very well marked species evidently related to *O. paniculatum*. Especially distinctive of the species are its broad leaves and its scanty indument in which the coarser components are reduced in size and comparatively sparse and inconspicuous. Compared with *O. paniculatum* the plant appears more luxuriant, glabrescent, and greener.

3. *Onosma chitralicum*, sp. nov.

Planta hispidissima (pilis patentibus 1–2 mm. longis) et abundanter minuteque hispidula (pilulis 0.1–0.2 mm. longis); caulibus infra medium ignotis, ad 4 mm. crassis, simplicibus vel solum apicem versus ramulo axillari 5–10 mm. longo sparse foliato floriferi donatis; foliis caulinis medionalibus lanceolatis crassiusculis acutis 2.5–4.5 mm. longis 3–8 mm. latis; cymis furcatis maturitate laxe racemosis 10–13 cm. longis; calyce sub anthesi 8–10 mm. longo 3–5 mm. longe graciliterque pedicellato lobis anguste lanceolatis 1–1.5 mm. latis villosulo-hispidis; calyce fructifero 10–12 mm. longo ad 8 mm. longe pedicellato, lobis ad 2 mm. latis rigidis; corolla 12–14 mm. longa a basi ad 2.5 mm. crassa sursum gradatim ampliata apicem versus 4–4.5 mm. crassa, extus subglabra vel minutissime puberulenta, intus glaberrima, in sicco brunnea; antheris 6.5–7 mm. longis, basaliter lateraliterque cohaerentibus, tubum formantibus, 2–2.5 mm. supra basim affixis, basibus 6–7 mm. infra sinus corollae positis; filamentis linearibus, 2–2.5 mm. longis, 5–6 mm. supra basim corollae affixis; nectario glabro 0.2–0.3 mm. alto; stylo ca. 15 mm. longo; nuculis nitidis laevibus 3–4 mm. longis.

INDIA (Northwest Frontier): Chitral, *S. M. Toppin* 481 (TYPE, Kew); Lowari Range, Chitral, 11000 ft., Aug. 1895, *Gatacre* 17345 (DD).

A very distinct and well marked species for which I can suggest no very close relative.

4. *Onosma hispidum* Wallich, Numerical List 26, sub no. 938 (1829), nomen; D. Don, Gen. Syst. 4: 317 (1838).—“native of Kamaon” *Wallich* 938.

Onosma echiioides sensu Clarke, Fl. Brit. India 4: 178 (1883); Blatter, Beautiful Flowers Kashmir 2: 60, t. 45, f. 3 (1928).

Plant perennial, bristly with spreading usually somewhat tawny hairs 2–5 mm. long, also minutely hispidulous; stems one to many, erect or ascending, simple or rarely branched, 1–5 or rarely 7.5 dm. long, 3–6 mm. thick towards base; leaves usually veinless, hispid and hispidulous on upper surface, the coarse hairs usually with discoid bases; basal leaves usually persisting at flowering time, oblance-linear to narrowly oblanceolate, 10–40 cm. long, 5–15 mm. broad, apex obtusish; middle cauline leaves linear-oblong or lance-oblong, obtusish, 4–8 cm. long, 4–10 mm. broad; cyme terminal, forked, at anthesis dense, 3–4 cm. broad, at maturity elongating, racemose, up to 15 cm. long; bracts lanceolate; calyx 12–15 mm. long at anthesis on pedicels 1–3 mm. long, lobes lance-linear, 1–2 mm. broad, tawny bristly, at maturity 15–25 mm. long on pedicels 5–10 mm. long, with lobes 1.5–3 mm. broad; corolla white, cream or pale yellow, 18–23

mm. long, from a base 3–3.5 mm. thick gradually expanding, 8–11 mm. thick just below the sinus, outside commonly sparsely hispidulous on the lobes and elsewhere very minutely puberulent, inside completely glabrous; anthers united basally and laterally to form a tube, 9–11 mm. long, attached ca. 2.5 mm. above base, tip to 2 mm. long, base held 8–11 mm. below level of corolla-sinus; filaments 5–6 mm. long, ligulate, arising 8–10 mm. above corolla base, decurrent base ad 5 mm. long; nectary a completely glabrous flange about 0.3 mm. high; style 13–23 mm. long, glabrous; nutlets 6 mm. long, smooth or obscurely roughened, somewhat lustrous.

Mountains of northwestern India, from Chitral to Kumaon.

INDIA: Seerenagur, *Kamroop in herb. Wallich* (K); above Jangla, Tehri-Garhwal, July 7, 1883,—no. 347A (DD); Saugla, Baspa Valley, Simla Hills State, 12000 ft., fl. pale yellow, *Ludlow & Sherriff 7372* (G); Rogi Cliffs, Bashahr, 9000 ft., fl. greenish white, *Laurie 5403* (Ed, DD); Rogi in Kunawar, *Nanale* (DD); Rogee, *herb. Royle* (DD); Rong Gael, Tidong Valley, Bashahr, hot shale slopes 9500 ft., *R. M. Gorrie* (DD); Kauacharanga, Bashahr, 10000 ft.,—no. 62 (DD); Kunawar, 1885, *Drummond 22228* (UC, Ed); Chini Cliffs, Upper Kanawar, 9200 ft., *J. H. Lace 282* (Ed); Jashrang Cliffs, Bashahr, 9800 ft., fl. creamy white, *Parker 2914* (G, DD); Pricker, Lahul, 12000 ft., fl. yellow, *Bor 14852* (Ed, DD); Ganlur, Lahul, dry slopes, 10200 ft., dry slopes, fl. yellow, *Bor 15284* (Ed, DD); Dartse to Patseo, Bhaga, Lahul, *Schlagintweit 4092* (G); Dartse to Tsanskar Sumdo, *Schlagintweit 4132* (G); Lulu to Lahaul, 1888, *Drummond 22919* (UC, Ed); Kolong, Chenab Valley, Bashahr, 11000 ft., *T. R. Chand 115* (US); Pangi, Vhatwani Forest, Chamba, 9000 ft., *Harsukh* (UC); Pangim Chanba, Aug. 1880,—no. 280 (DD); Luj Forest, Chamba, 10000 ft., *Harsukh* (DD); Luj Forest to Pangi, 1897, *Lace* (Ed); Kagan Valley, Hazara, 8000 ft., *Inayat 19480* and *19481* (DD); Dis Valley, Chitral, 6000 ft., May 1895, *Gatacre 17344* (DD); Madajlast, Chitral, 10000 ft., July 1908, *Toppin 509* (K); Sai, 8000 ft., 1880, *Tanner 6* (DD); Ribe, 9000 ft., Sept. 1864, *Brandis 4137* (DD).

KASHMIR: below Traghul, 7–8000 ft., *R. R. Stewart 19438* (G); Tannin to Zojbal, 11000 ft., *J. R. Drummond 14202* (Ed); Machel, Sapphire Mines, Kishtawar, 9000 ft., open bracken-covered hillslope, fl. cream, *Ludlow & Sherriff 9124* (G); Matayan, Dras, 11000 ft., July 31, 1891, *G. A. Gamie* (DD); Chatpani nullah, west of Dras, 10–12000 ft., Aug. 27–28, 1893, *Duthie s. n.* and *13814* (DD); Joginai spur, opposite Jaodon Valley in Tilail, Kishanganga Valley, 12000 ft., 1909, *Keshavanand 1440* (DD); near Gagangir, Sind Valley, 7800 ft., June 25, 1892, *Duthie 11468* (DD); below Baltal, Sind Valley, 9–10000 ft., June 26, 1892, *Duthie 11566* (DD); Gudhai Valley, Astor Dist., 12–13000 ft., July 21, 1892, *Duthie* (DD); Kinimola nala, Liddar Valley, May 23, 1901, *Inayat* (UC).

4A. *Onosma hispidum* var. *kashmiricum*, comb. nov.

Onosma kashmirica Johnston, Jour. Arnold Arb. **21**: 50 (1940).—Type from Pan Dras, Ladak Road, Kashmir, *R. R. Stewart 10053*.

Corolla longer and proportionately more elongate than in the type form, about three times longer than broad, 28–30 mm. long; filaments longer (7–9 mm.) and affixed higher on the corolla (12–13 mm. above base).

KASHMIR: Pan Dras, Ladak Road, 10000 ft., *R. R. Stewart 10053* (G, TYPE); Tashgam, Treaty Road, Ladak, stony hillslope, fl. cream, *Ludlow & Sherriff 8340* (G); Shumkergadh, Kaminala, Astor Valley, *Inayat 25702* (DD); without locality, *herb. Falconer* (G); without locality, 5-8000 ft., *T. Thomson* (G).

This species appears to be the most common and widely distributed *Onosma* in the western Himalayas. Certainly it has been collected more frequently than any other species in our area. Though in the past usually identified with *O. echioides* L. it is not at all closely related to that species of Europe. Among the Indian species only *O. dichroanthum* has any particular relations with the latter. The immediate relations of *O. hispidum* are with *O. Gmelini* Ledeb. of the Altai.

Onosma hispidum has a distinctive habit and is usually recognizable at a glance. In its area its strong root, clustered coarse stems, persisting elongate basal leaves and slightly tawny very bristly indument are distinctive. Except in parts of Kashmir, another distinctive feature is its short stout corollas, generally about twice as long as broad. A form of the species in Kashmir, however, has longer and proportionately more elongate corollas, generally about three times longer than broad. It has been distinguished as the var. *kashmiricum*. It comes from an area in which the typical form of the species has been found and differs from it only in corollas. It merits recognition only because of the uniformity of the species elsewhere over its wide area of distribution.

5. *Onosma khyberianum*, sp. nov.

Planta ut videtur perennis hispidissima et minute hispidula pilis conspicuis pallidis 1.5-4 mm. longis et pilulis inconspicuis 0.05-0.1 mm. longis obsita; caulibus pluribus erectis adscendentibusve 15-25 cm. longis basim versus 3-4 mm. crassis simplicibus; foliis firmis enervatis, in facie superiore basibus pilorum discoideis pallidis praeditis; foliis basalibus 4-9 cm. longis 5-9 mm. latis anguste oblanceolatis acutis obtusisve tempore florendi persistentibus; foliis caulinis superioribus ca. 4 cm. longis 5-6 mm. latis acutis; cymis solitariis terminalibus simplicibus vel rare furcatis, sub anthesi cernuis ca. 5 cm. diametro; bracteis lanceolatis ad 2.5 cm. longis et 6 mm. latis apice longe attenuatis; calyce ad anthesin 18-23 mm. longo 2-4 mm. longe pedicellato, lobis 15-20 mm. longis anguste lanceolatis apice attenuatis; corolla alba vel ochroleuca, 30-32 mm. longa, a basi 2-3 mm. crassa sursum gradatim ampliata, apicem versus 8-10 mm. crassa, extus lobis deltoideis 2.5-3 mm. latis longisque pilulis sparsis donata alibi glabra; antheris 11-13 mm. longis basaliter lateraliterque cohaerentibus tubum formantibus, 3-4 mm. supra basim affixis, basibus 5-8 mm. infra sinus corollae positis, apicibus sterilibus 1.5-2 mm. longis exsertis, connectivo tumido muriculato; filamentis 9-10 mm. longis, ligulatis, basim versus ampliatis, 13-15 mm. supra basim corollae orientibus, basi 5-6 mm. longe decurrentibus; nectario glabro lobulato 0.2-0.4 mm. alto; nuculis ad 3 mm. longis, nitidis, laevis.

INDIA (Northwest Frontier): Khyber Pass, rocky mountains, 3700 ft.

alt., stems ascending, fl. drooping, corolla white, April 9, 1899, *H. H. Johnston* 22 (TYPE, Edinburgh); Landi Kotal, rocky hillsides, 3600 ft., leaves grayish intensely bristly, fl. creamy white fading to yellow, March 30, 1942, *D. L. 709* (Ed).

Distinctive of the species are its slenderly attenuate bracts, very elongate corollas, and large handsome nodding cymes; all characters readily separating it from its closest relative, *O. Griffithii*. The two specimens cited are both from Khyber Pass. Possibly it may occur also in Chitral. An incomplete specimen at Dehra Dun (*Gatacre 17343* from 7000 ft. in Baraul Valley) possibly is conspecific. It differs from the type form in having acute, rather than attenuate bracts, as well as in its somewhat tawny, rather than pale, indument.

6. *Onosma barbigerum*, sp. nov.

Planta ut videtur biennis hispidissima et minute hispidula pilis conspicuis gracilibus pungentibus 3–5 mm. longis cinereis et pilulis inconspicuis patentibus abundantibus 0.05–0.1 mm. longis donata; caulibus pluribus, erectis vel adscendentibus, simplicibus, 1.5–4 dm. longis, basim versus 4–7 mm. crassis; foliis viridibus, hispidis, haud vel vix nervatis, in facie superiore basis pallidis discoideis pilorum notatis; foliis basalibus oblanceolatis, 8–16 cm. longis, 8–17 mm. latis, apice acutis obtusisve; foliis caulinis medionalis oblongis vel elliptico-oblongis, 3–5 cm. longis, 8–14 mm. latis; cymis terminalibus, simplicibus vel furcatis, sub anthesi 4–6 cm. latis, maturitate elongatis racemosis 8–12 cm. longis; bracteis lanceolatis; calyce sub anthesi 15–20 mm. longo 1–3 mm. longe pedicellato, maturitate 18–23 mm. longo, 2–6 mm. longe pedicellato, lobis linearibus vel lineari-lanceolatis; corolla 22–25 mm. longis, a basi 2–3 mm. crassa sursum gradatim ampliata, infra sinus 7–9 mm. crassa, extus lobis deltoideis 2.5–3 mm. latis longisque pilulis sparsis donata alibi glabra; antheris basaliter lateraliterque cohaerentibus, tubum formantibus, 9–12 mm. longis, 2.5–3.5 mm. supra basim affixis, basibus 6–9 mm. infra fundum sinuum corollae positae, apicibus sterilibus 1–2 mm. longis saepe exsertis, connectivo tumido muriculato; filamentis 6–8(–9) mm. longis, ligulatis, basim versus plus minusve ampliatis, 10–13 mm. supra basim corollae orientibus, basi 5–7 mm. longe decurrentibus; nectario anguste glabro lobulato ad 0.4 mm. alto.

BALUCHISTAN: Quetta, 1888, *Duthie 8682* (TYPE, Dehra Dun); Hanna, 7000 ft., 1888, *Lace 3776* (DD); Moorga to Hindubagh, 5500 ft., May 5, 1895, —no. 18925 (DD); without loc., 1891–4, *C. F. Elliott* (DD); without loc., *Sticks 1137* (DD).

AFGHANISTAN: without loc., *Griffith 5947* (G).

A coarse, very bristly herb notable among its close relatives for its relatively broad green leaves.

7. *Onosma Griffithii* Vatke, Zeits. Gesammten Naturwiss. (Berlin) 45: 127 (1875). — Type from "Afghanistan," *Griffith 5947*.

Plant apparently perennial, cinereous, bristly with stiff slender hairs 2–3 or sometimes 5 mm. long, also minutely hispidulous with hairs 0.05–

0.1 mm. long; stems several, 1-3 dm. tall, simple or occasionally with short floriferous branchlets near the apex, 2-5 mm. thick towards the base; leaves firm, rarely with visible veins, upper surface with the bristles frequently antrorsely appressed; basal leaves linear-ob lanceolate, 6-10 cm. long, 4-12 mm. broad, obtuse; middle cauline leaves linear, 3-5 cm. long, 3-7 mm. broad, acute or obtuse; cymes terminal, simple or sometimes forked, at anthesis 3-4 cm. broad; bracts lanceolate; calyx at anthesis 15-20 mm. long, lobes subulate-linear, 1-1.5 mm. broad, pedicel 1-3 mm. long; mature calyx 18-23 mm. long, lobes 2-3 mm. broad, pedicels 5-10 mm. long; corolla 27-30 mm. long, from a base 2.5-3 mm. thick gradually ampliate, becoming 7-8 mm. thick below the sinus, entirely glabrous or with a few hairs on the outside of the lobes; anthers 11-12 mm. long, united into a tube, affixed 3.5-4 mm. above base, base held 7-8 mm. below level of corolla-sinus; connective thickened, muriculate; filaments 8-9 mm. long, ligulate, arising 12-15 mm. above base of corolla, decurrent base 4-7 mm.; nectary narrow, lobulate, less than 0.5 mm. high, glabrous.

INDIA: Razani, Waziristan, 8000 ft., fl. white, Apr. 1924, *A. G. Lester-Garland* (K); Waziristan, *Harsukh 15805* (DD); Leakesur, Salt Range, Punjab, March 22, 1881, *Fleming* (Ed); Bundai, Chitral, *Harriss 16404* (DD).

AFGHANISTAN: without loc., *Griffith 5947* (DD, TYPE number).

What is here called *Onosma Griffithii* is an extremely unsatisfactory concept. It includes plants showing evident relations with *O. khyberianum* as well as with *O. barbigerum* and possibly is an aggregate. Furthermore, the name applied to it is one associated with much doubt.

The proper classification and the precise relations of the plants here referred to *O. Griffithii* can be established only after the study and analysis of a larger series of better specimens from western India than has been available to me. *Onosma Griffithii* Vatke was published in a journal not readily available to most botanists and was described as follows: "*Onosma* (*Euonosma*) *Griffithii* Vatke. totum setis longis albis patulis e tuberculo glabro ortis dense vestitum, caulibus e rhizomate pluribus adscendentibus diffusis simplicibus, foliis basalibus oblongo-lanceolatis basi petiolatim angustatis, caulinis sessilibus, superioribus ovato-lanceolatis, omnibus obtusiusculis, spicis brevibus plurifloris, calycis albo-setosissimi laciniis lanceolatis, corollae glabrae calyce parum longioris lobis brevibus obtusis reflexis, antheris filamentis subtriplo longioribus ad medium fere exsertis. In Afghanistan coll. Griffith! n. 5947 ex distrib. kew. 1863-4 (n. 5946 ejusdem coll. ex. sp. nimis incompleto determinare nequeo.) Planta alt. fere 2 dm.; folia inferiora ad 7 cm. longa, ad 1 cm. lata subtus costa margineque praecipue setosa; corollae tubus c. 2 cm. longus."

The diagnosis is ambiguous and, I suspect, probably hastily and carelessly prepared. *Griffith 5946* is the type-collection of *O. limitaneum* var. *majus* Johnston. Unhappily there is some doubt as to the identity of the plant available to Vatke as *Griffith 5947*. This type, formerly at Berlin, was a casualty in the recent war. The number appears to be associated

with a mixture of closely related species. Stroh, Beih. Bot. Centralbl. 59^b: 433 and 435 (1939), cites *O. Griffithii* in the synonymy of both *O. setosum dichroanthum* and *O. stenosphon*. A duplicate at the Gray Herbarium (though imperfect) appears to represent *O. barbigerum*. Another at Dehra Dun I am accepting as representative of *O. Griffithii*, since it agrees better with the description of the species. Vatke's description, however, calls for a plant with a rhizome, a corolla 2 cm. long, and anthers exerted to the middle and about three times as long as the filaments. These are developments very different from those found in either of the duplicates of *Griffith 5947* available to me. Since I doubt the accuracy of Vatke's diagnosis I have ignored the discrepancies noted.

8. *Onosma Waltoni* Duthie, Kew Bull. 1912: 41 (1912). — Type material from Gyantse, Tibet, *Walton 60, 1560 and 1562*.

Plant "perennial, suffrutescent at base," stems becoming at least 3 dm. long and 2.5 mm. thick, hispid (hairs 1–2 mm. long, straight, spreading, bulbous-based, moderately numerous) and also retrorsely appressed hispidulous (hairs abundant, 0.1–0.3 mm. long); leaves "2–4 cm. long, 6–8 mm. broad," firm, veinless, upper surface hispid and hispidulous (the hairs loosely appressed and all bulbous based), lower surface sparingly bristly; basal leaves not seen; cauline leaves oblanceolate, 2–4 cm. long, 4–6 mm. broad, obtuse base broadened and semi-amplexicaul; cymes solitary, terminal on main stems and on slender peduncles 1–3 cm. long arising from many leaf-axils, at anthesis dense, 1–2 cm. broad; calyx at anthesis 6–7 mm. long, appressed white villose inside, outside pungently bristly, pedicel 1–3 mm. long, in fruit almost 9 mm. long with pedicels up to 8 mm. long; corolla 14 (fide Duthie 10–30) mm. long, from a base 1.5–2 mm. thick gradually expanded, becoming 6–7 mm. thick just below the sinus, texture unusually thin, densely but very minutely and inconspicuously puberulent, evidently hairy only on the nectary and outside near tip of lobes; corolla-lobes triangular, 2 mm. broad, 1.5 mm. long; anthers 7 mm. long, coherent basally and laterally to form a tube, affixed 2–2.5 mm. above base, base borne ca. 5.5 mm. below level of corolla-sinus; filaments very slender, 3–3.3 mm. long, arising 6.5–7 mm. above corolla-base, very minutely and inconspicuously puberulent, decurrent base about 3 mm. long, linear, puberulent, marked by a slight intrusion on outer surface of corolla; nectary villose, membranous, ca. 0.2 mm. high, apparently lobulate; style 15 mm. long, glabrous; nutlets 2.5–3 mm. long, lustrous, white, obscurely "tuberculate" or rugose.

TIBET: Gyantse, 1904, *Walton s. n.* sub *O. Waddellii* (Ed).

My account of this species is based upon the unnumbered collection made by Walton cited above. Though labeled "*Onosma Waddellii* Duthie, n. sp.," it agrees reasonably well with the original description of *O. Waltoni* and was collected at the same locality and by the same collector as the numbered syntypes of that species. It differs from the original description in having corollas 14 mm., rather than 10–30 mm. long, and in having

the filaments arising at or near the middle of the corolla and not, as Duthie infers, distinctly below the middle. The species described is a well-marked one and is perhaps most closely related to *O. Waddellii*. From that species it differs in having a more elongate, more cylindrical corolla which not only has a thinner texture, but is also more abundantly puberulent on the outer surface. Its filaments are borne near the middle of the corolla, not below, and are decidedly puberulent. The decurrent base of the filaments is linear, more elongate, and decidedly puberulent, not lanceolate nor tumid. The stem-leaves are more broadly sessile. The puberulence on the corolla of *O. Waltoni* is very distinctive. It is composed of abundant, very minute, short thickish hairs, and at times appears somewhat farinose.

***O. Onosma Wardii* (W. W. Sm.), comb. nov.**

Onosma Hookeri var. *Wardii* W. W. Smith, Notes R. Bot. Gard. Edinburgh 9: 113 (1916).—Type from Ka-gwr-pw [Ka-kar-po] mountain, northwestern Yunnan, *Ward s. n.*

Plant perennial, arising from a dye-stained taproot, indument slenderly hispid (hairs 1.5–5 mm. long, ascending) and villulose (hairs pale, 0.2–0.3 mm. long); stems ascending or decumbent, several, 3–6 dm. long, usually simple, 3–5 mm. thick towards base, hispid and retrorsely villulose; leaves with upper surface green, with appressed bristles 1.5–3 mm. long, arising from discoid bases, lower surface pale, abundantly villulose and hence somewhat velvety, coarse hairs few; basal leaves persisting at anthesis, oblanceolate, 10–18 cm. long, 1–2 cm. broad, acute; middle cauline leaves lanceolate or oblong-lanceolate, acute, 5–9 cm. long, 6–12 mm. broad, base acute to rounded; cymes simple, terminal on the main stem and on short peduncles in the uppermost axils, at anthesis 3–5 cm. broad; calyx 7–17 mm. long, villose, pedicels 5–15 mm. long; corolla "purplish blue," 10 mm. long, antrorsely strigose outside, inside appressed villose along a line below each corolla-lobe, except for the villose nectary otherwise glabrous, from a base 2 mm. thick gradually expanding and becoming 10–11 mm. broad at the level of the sinus; anthers 10 mm. long, joined basally and laterally to form a tube, affixed 2–3 mm. above base, sterile apex ca. 2 mm. long, base carried 9 mm. below level of corolla-sinus; filaments 6.5 mm. long, arising 6.5 mm. above corolla-base, decurrent base 3–3 mm. long; nectary 0.2 mm. high, lobed, villose; nutlets not seen.

CHINA (Northwest Yunnan): Temple, Ka-gwr-pw, Mekong-Salween divide about lat. 28°30', 13000 ft., July 26, 1913, *Ward 902* (Ed, TYPE; S, ISOTYPE); specimen grown in England from seed collected by Ward, subo. 902, 1914, *Bees Ltd.* (Ed).

This plant from near the Tibetan border in northwestern Yunnan in cross habit very much resembles *O. Hookeri* var. *intermedium* of southeastern Tibet. By coincidence the two plants were given confusingly similar names when they were originally described. Our plant was called *O. Hookeri* var. *Wardii* W. W. Sm. (1916) and that from Tibet *O. Hookeri* subsp. *Wardii* Stapf (1931). These two plants, however, differ in many

respects and are obviously different species. In our plant, *O. Wardii*, the corolla is strigose outside and has a vertical line of hairs below each lobe on the inside of the throat. Its anthers are united into a tube and its filaments arise below the middle of the corolla. In the Tibetan plant (now called *O. Hookeri* var. *intermedium*) the larger corolla is villose-strigose outside and glabrous on the throat inside. Its anthers are united at the base only and its filaments arise midway up the corolla. The decurrent bases of its filaments are narrow, thickish, and very prolonged. Despite their superficial resemblances, the two plants are probably not closely related. *Onosma Wardii* probably has its closest affinities with the habitually dissimilar *O. confertum*.

10. *Onosma confertum* W. W. Smith, Notes. R. Bot. Garden Edinburgh 8: 106 (1913).—Type from mountains enclosing Lang Kong River, Yunnan, *Forrest 6436*.

Onosma Forrestii W. W. Smith, Notes R. Bot. Garden Edinburgh 8: 107 (1913) —based on garden plants grown from seeds collected in Yunnan by Forrest in 1910.

Plant arising from a coarse dye-stained taproot; stems usually single from the basal leaf-cluster, erect, 3–10 dm. tall, 3–9 mm. thick towards the base, sparingly hispid (hairs 1–3 mm. long, spreading or ascending, with a thickened base) and villulose-hispidulous (hairs 0.1–0.3 mm. long, appressed, mostly antrorse but tending to be retrorse below middle); leaves veinless, upper surface green, appressed or spreading hispid the hairs usually with discoid bases, lower surface sparingly hispid, usually pallid from an abundance of minute pale hairs; basal leaves usually dried at flowering time, oblanceolate, acute, 10–15 cm. long, 9–18 mm. broad; middle cauline leaves lanceolate, 4–12 cm. long, 5–15 mm. broad; cymes numerous, simple or forked, at anthesis 2–4 mm. broad, terminal on the stem and on slender peduncles 3–10 cm. long from the axils above the middle of the plant, hence in an elongate open panicle arrangement; calyx 9–12 mm. long, pedicels slender, 6–12 mm. long; corolla pink, red, or purple, 13–18 mm. long, from a base 1.5–2 mm. thick gradually expanded and becoming 7–11 mm. thick at the level of the sinus, evidently strigose outside, inside with hairy nectary and frequently with a line of hairs below each corolla-lobe but otherwise glabrous; anthers 6.5–8.5 mm. long, coherent basally and laterally to form a tube, affixed 1–1.5 mm. above base, base borne generally 6–7 mm. below level of corolla-sinus; filaments 5–8 mm. long, arising 3–4 mm. above corolla-base, decurrent base 2–2.5 mm. long, generally broadened and thickened downward towards the abruptly rounded lower end; nectary represented by five villose lobules; style glabrous 16–18 mm. long; nutlets 2.5–3 mm. long, brownish, angular, more or less warted.

Known from middle northern Yunnan and northward into western Sikkang.

YUNNAN: mountains enclosing Lang Kong River, lat. 26°10', dry arid situations, plant 2–3.5 ft. tall, 8000–9000 ft., fl. soft rose, *Forrest 6436* (Ed,

TYPE of *O. confertum*; G, UC, ISOTYPES); mountains forming Lang Kong gorge, southern boundary of Lang Kong Valley, lat. $26^{\circ}10'$, 8000 ft., plant 1-2 ft. tall, exceedingly dry rocky slope, fl. bright blue, *Forrest 5991* (Ed); Ahsi, northwest Likiang Snow Range on Yangtze, open ledges, plant 3 ft., fl. dull rose-purple, *R. C. Ching 20786* (G); Yülun-schau near Likiang, *Handel-Mazzetti 7009* (G); inter Lanticho et Poloti, reg. Yungning-Yungpeh, ad l. m., fl. obscure purp., 2500 m., *Schneider 1682* (G, Ed); Mt. Wuaha, Tungning Terr., pine forest, 10000 ft., fl. purplish red, *Rock 24234* (NY, Ed); Chungtien, *T. T. Yü 12496* (G); western Yunnan, *Forrest 28822* (G).

SIKANG: above Litang river, 9000 ft., shaded limestone cliff, *Ward 4263* (G, Ed); Muli, Ku-lu, Hai-yeh-tze, 3100 ft., *T. T. Yü 14323* (G); Muli, Gu-tu, 2200-2300 ft., *T. T. Yü 14211* (G).

WITHOUT LOCALITY: garden plant, grown from seeds collected by Forrest, flowered by Bees Limited in July 1912, *herb. Edinburgh* (Ed, TYPE of *O. Forrestii*).

A well-marked species to be confused only with *O. album*. The latter differs, however, in flower-color, extruded stamens, hairy style, and unthickened decurrent base of the filaments. In gross habit the two species are remarkably similar. When young these species have the habit of a biennial. The taproot develops a leaf-rosette the first season and the following season a single erect stem bearing paniculately disposed cymes. With biennials such as *O. paniculatum* the root dies after the fruiting season. Our present plant, about the base of its fruiting stem, forms short stout offsets which produce new leaf-clusters and eventually additional flowering stems.

The type of *O. Forrestii* is an abnormal plant grown in the British Isles from seed collected by Forrest during 1910, very likely along the Lang Kong River in northern Yunnan, where the type specimen of *O. confertum* originated also. The peculiarities of *O. Forrestii* probably resulted from growth in an unfavorable environment. In technical characters it agrees with *O. confertum* satisfactorily.

31. *Onosma sinicum* Diels, Bot. Jahrb. 29: 546 (1901). — Type from "Wen-chuan, Ta-chi-kou," Szechuan, *Rosthorn 3011*.

A suffruticose perennial; root woody; stem slender, 1-4.5 mm. thick; old stems loosely branched, sprawling or decumbent, 1-3 dm. long, producing numerous axillary leaf-fascicles or leafy floriferous branchlets, old parts leafless and decorticate; branchlets erect or ascending, slender, 5-15 cm. long, very leafy, hispid (hairs 1-2 mm. long, with a thickened base, spreading or ascending) and also hispidulous (hairs 0.1-0.4 mm. long, slender, erect or ascending); leaves all cauline, veinless, oblanceolate, 0.7-5 cm. long, 1.5-9 mm. broad, acute or obtusish, broadest at or above middle and gradually contracting to a very narrow or even subpetiolate base (or uppermost leaves lanceolate or even elliptic), upper surface usually appressed hispid (hairs ca. 1 mm. long, with discoid bases) and also minutely hispidulous, lower surface paler, abundantly hispidulous; cymes small, simple or rarely forked, at anthesis 1.5-2 cm. broad, in age uni-

laterally racemose and 5–10 cm. long, terminal on the leafy branchlets or borne on slender peduncles 1–2 cm. long arising from the uppermost leaf-axils; bracts small, lanceolate or ovate-lanceolate, 1–4 mm. long; calyx 7–9 mm. long, strigose to hispid-villose; lobes linear to lance-linear, 0.5–1 mm. broad; pedicel slender, at anthesis 1–3 mm. long, becoming 3–8 mm. long in fruit; corolla blue, 8.5–9.5 mm. long, from a base 2–2.5 mm. thick at first gradually then more abruptly expanded, becoming 4–6 mm. thick below level of sinus, outside antrorsely puberulent and sparsely strigulose; anthers 5.5–6.6 mm. long, united on base and sides to form a tube, conspicuously exserted, affixed 1–1.5 mm. above base, sterile tip very short about 0.5 mm. long, base carried 0–2 mm. below level of corolla-sinus; filaments 5–7 mm. long, slender, slightly thickened above the non-decurrent attachment, arising 2.5–3 mm. above corolla-base, conspicuously villose at the base; nectary consisting of 5–10 lobules 0.1–0.2 mm. long, densely villose; style 10–16 mm. long, glabrous; nutlets 2–2.5 mm. long, gray, dull, verrucose.

CHINA (Szechwan): Pehchuan Hsien, Sihchuan, on rocks, herb 5–8 inches tall, fl. blue, *W. P. Fang 5608* (G, Ed); Mo Hsien, Mowchow, roadside herb 1–2 ft. tall, fl. blue, *W. P. Fang 1503* (G, Ed); descending to Mao-kung Hsien, rocky place at roadside, 3000–3200 m., fl. blue, some red, *F. T. Wang 21298* (G).

This species is known only from northwestern Szechuan. The type was collected along the Min River about 100 km. northwest of Chengtu. The closest relative of the plant appears to be *O. Farrerii*, which ranges just north of it in southern Kansu. Both species have similar suffruticose habit and both have similar oblanceolate leaves contracted to a very narrow base. The flowers of the two species, however, are very different. In *O. Farrerii*, except for the sparingly hairy nectary, the corolla is glabrous inside. Its larger anthers have elongate sterile tips and its glabrous filaments have a broader base.

12. *Onosma burmanicum* Collett & Hemsley, Jour. Linn. Soc. London, Bot. 28: 93 (1891).—Type from Shan Hills, Burma, at 4000 ft., "once met with, growing gregariously on a grassy hill-side on road from Koni to Fort Stedman, by way of the Inleywa Lake," *Collett 941*.

Plant becoming at least 1 m. tall and possibly shrubby; stems elongate, unbranched, erect, 5 mm. thick towards the base, somewhat woody, apparently vegetative during several years, producing a very crowded mass of foliage (internodes ca. 1 mm. long) and lengthening only 0.5–1.5 dm. each season, during the final season lengthening at least 4–5 dm. (internodes as much as 20 mm. long) and terminating in the inflorescence; leaves on sterile stems 6–11 cm. long, from the sessile base 2–5 mm. broad very gradually narrowed towards the apex, linear-cuneate, extremely numerous and crowded, ascending or spreading, in age deflexed, dead ones persisting and clothing the older portions of the stem, margins usually strongly revolute and more or less obscuring the lower surface, upper surface green scabrous hispid (hairs slender, 1 mm. long, with a pallid bulbous base),

lower surface usually pallid from an abundance of slender appressed silky hairs; leaves on elongate floriferous shoot lanceolate to cuneate, 3–4 cm. long, 3–6 mm. broad, sessile, narrowly revolute, upper surface with appressed hairs lacking bulbous bases, lower surface smooth, white, silky strigose; inflorescence loosely paniculate, composed of numerous cymes borne on bracteate peduncles (1–5 cm. long) springing from the axils along the upper 1–2 dm. of the main stem, 10–15 cm. broad, 10–30 cm. long; cymes small, at anthesis 1–2 cm. broad, at maturity straightening and lengthening, becoming about 5 cm. long; calyx 8–10 mm. long, lobes 0.5–1 mm. broad, linear; pedicels 3–5 mm. long at anthesis, later as much as 10 mm. long; corolla 10.5–13 mm. long, with a short subcylindric tube 2–2.5 mm. broad and 2.5–3 mm. long, then with a gradually ampliate throat becoming 5–7 mm. in diameter at the level of the sinus, with tight inflexed vertical pleats below each sinus, outside abundantly antrorse strigose above the middle, inside conspicuous villulose in a band 2–4 mm. above the base, except for the villulose nectary otherwise glabrous; anthers 7–10 mm. long, united into a tube, conspicuously exserted, affixed 1.5–2.5 mm. above base, sterile tip 2–2.5 mm. long, base carried 1.5–2.5 mm. below level of corolla-sinus; filaments 5.5–7.5 mm. long, very slender, hairy towards base, not decurrent, arising 2.5 mm. above corolla-base; nectary very narrow, lobed, villulose, ca. 0.1–0.2 mm. high; style 11–17 mm. long, glabrous; nutlets 3–3.5 mm. long, dull, brownish, verrucose.

BURMA: Fort Stedman, Upper Burma, lat. $20^{\circ}30'$, Dec. 1892, *Abulhak* (DD); Shan Hills, Koni dist., 4000 ft., Nov. 12, 1888, *H. Collett* 941 (K, TYPE); Gawle Reserve, Thaungyun Div. (ca. lat. $16^{\circ}30'$), hilly ground, brown, Sept. 20, 1924, *Burman Collector* (DD, G).

A very distinct species, remarkable in a number of respects. It is the most southerly ranging species in the entire genus. Its habit of growth is unlike that of other congeners. Unhappily collectors have not provided information concerning the appearance and behavior of the living plant. From what can be deduced from the specimens available, it is probably shrubby, and very likely becomes more than a meter tall. Its growth-habit may suggest that of some of the smaller shrubby species of *Echium* known from the Canary Islands. Certainly no other member of *Onosma* develops simple erect shrubby stems which annually produce a dense new terminal leaf-cluster after a yearly growth of only 5–10 cm. until finally, after slow growth and vegetating for as much as five years, they terminate in a final season by lengthening as much as 5 dm. and by producing flowers. The vegetative branches are about 5 mm. thick, have very short internodes, and bear their very slender elongate functional leaves in a brush-like terminal cluster above the skirt-like mass of dead persisting reflexed leaves from previous seasons.

The material I have examined comes from two areas separated by some 100 miles; one from the Shan Hills near Lake Inle, lat. $20^{\circ}30'$, and the other from near the Siamese border, east of Moulmein, at about lat. $16^{\circ}30'$. Comparable parts from the two are very similar; indeed, the chief

difference appears to be in their pubescence. In the northern material the hairs along the stem and on upper leaf-face are tightly appressed, whereas in the southern material they are loosely appressed or ascending. The collection from the south is of great interest, since it includes sterile vegetative stems (described above) as well as the flowering shoot. The type from middle eastern Burma consists of the flowering shoot only.

13. *Onosma hypoleucum*, sp. nov.

Planta perennis fruticulosa pallida; caulibus foliosis, gracilibus, 3–5 dm. altis, basim versus 1–2.5 mm. crassis, pluribus, e basi lignosa orientibus, saepe erectis simplicibusque, sparse hispidis (pilis 1–1.5 mm. longis patentibus vel adpressis e basi pallida bulbosa orientibus) et abundanter albo-strigulosis (pilulis 0.1–0.4 mm. longis antrorsis); foliis numerosissimis oblanceolatis vel lineari-lanceolatis 1.5–3 cm. longis 1.5–5 mm. latis nervatis firmis margine revolutis, in facie superiore cinereis basibus pallidis pilorum majorum notatis, in facie inferiore albis abundantissime sericeo-strigulosis; cymis sub anthesi ca. 2 mm. latis, maturitate elongatis ad 10 cm. longis, terminalibus et e axillis supremis 1–3 cm. longe pedunculatis; calyce 10–13 mm. longo, lobis linearibus 0.5–1 mm. latis, pedicello gracili 1–10 mm. longo; corolla coerulea 10–11 mm. longa a basi 2 mm. crassa sursum ampliata sinus versus 4–5 mm. crassa extus minute abundanteque antrorso-strigosa, intus parte 1.5–2.5 mm. supra basim villosa, lobis 1–2.5 mm. latis 1–1.5 mm. longis margine revolutis; antheris 9–10 mm. longis in tubum cohaerentibus exsertis 1.5–2 mm. supra basim affixis, apicibus sterilibus 1–1.5 mm. longis, basibus ca. 2 mm. sub sinus corollae positis; filamentis 6–7 mm. longis 1.5–2 mm. supra basim corollae orientibus, a basi 0.3–0.5 mm. lata haud decurrenti sursum gradatim ampliatis ca. 0.5–1 mm. supra basim latissimis (0.5–0.7 mm. latis) deinde apicem versus gradatim attenuatis, parte 1–2 mm. longa infima villosis; nectario angusto lobato 0.1–0.3 mm. alto villoso; stylo 15 mm. longo glabro; nuculis 2.5–3 mm. longis nitidis pallidis obscure rugulosis.

Known only from the northwestern Himalaya, long. 73° to 76°30'.

INDIA: Changla Gali, Murree Hills, Punjab, 6500 ft., cliffs, fl. blue, Aug. 27, 1918, *R. R. Stewart* 3956 (NY); Nagan, Muzaffarabad, range forest, Kishanganga Valley, Kashmir, 10000 ft., Sept. 1, 1907, —no. 1807 (DD); Chamba, 1896, *G. A. Gammie* (DD); Dharmsala, Kangra dist., Punjab, *Edgeworth* (DD); without loc., *J. L. Stewart* 2239 (Ed); without loc., *Falconer* (TYPE, Gray Herb.).

It is surprising that this well-marked species has remained so long confused with *O. Thomsoni*, a habitally very similar plant also found in the front ranges of the northwestern Himalaya. The present plant does have more slender stems and smaller leaves beautifully silky strigose and white beneath, but the most marked differences from *O. Thomsoni* are those inside the corolla. The blue corollas of *O. hypoleucum* have a broader throat which outside is finely and evenly antrorse-strigose, not retrorsely strigose as in the white corollas of *O. Thomsoni*. This difference in pubescence is particularly well marked on the flower-buds. Inside the corolla is

evidently villose in a band 1.5–2.5 mm. above the base. Its filaments are hairy and perceptibly constricted just above their narrow attachment. In *O. Thomsoni* the filaments are glabrous and have a broad arcuate attachment and are not basally constricted. The two species are not even closely related.

14. *Onosma exsertum* Hemsley, in Hook. Icones Pl. 27: t. 2639 (1900).

— Type from grassy hills near Mengtze, Yunnan, *Henry 9334*.

Plant robust, 3–12 dm. tall, biennial; stem single, branched only in inflorescence, 5–10 mm. thick towards base, hispid (hairs 1–2 mm. long, few to many, ascending or closely and antrorsely appressed, base thickened) and also very minutely and inconspicuously hispidulous (hairs 0.1 mm. long); leaves somewhat coriaceous, veinless, upper surface green, strigose (hairs rigid, ca. 1 mm. long, with evident discoid bases), minute hairs scarce or none, lower surface with abundant minute hairs, ca. 0.1 mm. long and less abundantly and coarsely strigose; basal leaves developed the first year, oblanceolate, up to 30 cm. long and 7 cm. broad, obtusish; middle cauline leaves lanceolate or lance-oblong, acute 5–10 cm. long, 1.5–3 cm. broad; cymes numerous, relatively loose, 1–3 cm. broad at anthesis, terminal on the main stem and also on slender naked peduncles (3–10 cm. long) arising from the axils along the upper half of the main stem, hence displayed in a loosely paniculate arrangement; calyx 7–10 mm. long; lobes lanceolate, thickish, densely clad with short stout closely appressed thick-based hairs; pedicels 3–14 mm. long; corolla red then purple, 9–11.5 mm. long, with a subcylindric base 2 mm. thick and 3.5–4.5 mm. long and then expanding into a somewhat campanulate throat becoming 4.5–5 mm. thick, outside hispidulous or strigulose, usually retrorsely so, inside scantily strigulose along a vertical line below the lobes but otherwise glabrous; anthers 5.5–6.5 mm. long, united into a tube, usually completely exserted, affixed 1.5–2.5 mm. above base, sterile tips ad 1 mm. long, base carried at or above the level of the corolla-sinus; filaments 7.5–9.5 mm. long, subulate, glabrous, affixed 2.5–3.5 mm. above base of corolla, decurrent base 0.5–1 mm. long; nectary a very narrow glabrous collar 0.1–0.2 mm. high; style glabrous, 15–19 mm. long; nutlets ca. 3 mm. long, lustrous, pale, rugulose.

Southwestern China, in Yunnan and southern Sikang.

YUNNAN: Mengtze, *Henry 9334* (NY, US) and *9334B* (US); western flank of Tali Range, lat. 25°40', 9000 ft., open stony pasture, plant 3 ft., fl. deep maroon, *Forrest 11586* (Ed); betw. Tsuyung and Gwangdung, ca. lat. 25°, *Handel-Mazzetti 4826* (G); Chungtien plateau, lat. 27°30', open stony pasture, 9000 ft., *Forrest 12752* (Ed).

SIKANG: He-chang Hsien, mountain slope, open place, 1850 m., herb 2–4 ft. tall, fl. purplish blue, July 8, 1932, *T. T. Yü 1164* (G).

A very well marked species lacking any obviously close relative. It is notable for the coarse, short, closely appressed or even incurving hairs abundant on the inflorescence and especially on the pedicels and calyx, and frequently on the upper leaf-face also. Among the species with a

single very coarse tall stem it is readily recognized by the combination of completely exserted anthers and small corolla with rather well differentiated tube and throat.

15. *Onosma fistulosum*, sp. nov.

Planta robusta elata biennis; caulibus solitariis (fortasse supra medium ramulis floriferis gestis) fistulosis basim versus 8–14 mm. crassis hispidis (pilis 2–4 mm. longis patentibus retrorseve basi bulbosis); foliis in facie superiore viridibus scabris hispidulis (pilis abundantibus rigidiusculis patentibus 1–2 mm. longis basi pallida bulbosa orientibus), in facie inferiore nervatis hispidulis vel abundanter pallideque strigulosis et sparse hispidulis; foliis infimis ad 4 dm. longis et 4–6 cm. latis medium versus vel supra medium latioribus deinde apicem acuminatum versus gradatim contractis, basim versus in petiolum alatum ad 5–7 mm. latum et 10 cm. longum attenuatis; foliis caulinis medium versus latioribus utroque attenuatis, majoribus ad 2–2.5 dm. longis et 4–5 cm. latis; cymis fortasse numerosissimis in paniculatum amplam collectis sub anthesi 2–3 mm. latis; calyce 9–12 mm. longo basim versus hispido, lobis 1–1.7 mm. latis lanceo-linearibus; pedicello gracili 6–12 mm. longo; corolla 11–15 mm. longa a basi 2 mm. crassa primo leviter deinde validiore ampliata sinus versus 7–10 mm. crassa, extus supra medium sparse antrorseque strigulosa, intus (nectario excepto) glabra; lobis triangularibus 3–4 mm. latis 1.5–2 mm. longis margine revolutis; antheris 7–8 mm. longis in tubum cohaerentibus exsertis ad 2 mm. supra basim affixis, apicibus sterilibus 1.5–2 mm. longis, basibus 1–4 mm. infra sinus corollae positis; filamentis 7–9 mm. longis subulatis glabris 3–4 mm. supra basim corollae orientibus basi haud vel vix decurrentibus; nectario angusto 0.1–0.2 mm. alto lobato villosio; stylo 14–18 mm. longo glabro; nuculis ignotis.

CHINA: "Szechuan" [but probably within present-day Sikang], "en route," July 25, 1905, 5000 ft., fl. reddish, suffused purple, *E. H. Wilson* 4165 (G); Wachin, Muli, Sikang, oak forest, 3000 ft., Sept. 1937, *T. T. Yü* 14385 (TYPE, Gray Herb.).

A very well marked plant and probably the largest and most robust in the genus. It has a coarse single stem probably reaching 1–2 m. in height, and no doubt displays its cymes in a very large and ample panicle. The material available shows the stout biennial root and the base of the stem as well as some large basal leaves. Also available are sections of the coarse stem showing the leaves and one of the axillary floriferous branches produced by it. The coarse main stem, though becoming more than a centimeter thick, is hollow and pipe-like. The shell of conductive and support tissue surrounding the large central cavity is 1–3 mm. thick. In old stems it becomes hard and woody. The two collections studied have inadequate data. That from Yü was received with a collection-number but no field data. The locality I have given for it is that associated with other collections in the same gamut of numbers. Wilson's collection has no other data than that it was collected in Szechuan, "en route," on July 25

[? or 23], 1903. During the period of time indicated he was traveling in eastern Sikang. His collection is very similar in appearance to that of Yü.

16. *Onosma multiramosum* Handel-Mazzetti, Anzeiger Akad. Wiss. Wien 61: 166 (1924) and Symb. Sinicae 7²: 817 (1936). — Type from Yangtze about lat. 27° 45', *Handel-Mazzetti* 7596.

Plant apparently perennial; stems erect or decumbent, 2–6 dm. long, becoming as much as 6 mm. thick towards the apparently persisting base, usually with numerous branchlets, hispid (hairs 1–4 mm. long, spreading, frequently pungent, base bulbous) and hispidulous (hairs abundant, 0.1–0.4 mm. long, retrorsely appressed) leaves usually veinless, numerous, all cauline, somewhat cinereous, hispid (hairs spreading, 1–2 mm. long, those on upper surface with bulbous base) and also abundantly hispidulous (hairs 0.1–0.2 mm. long, erect); lower leaves oblanceolate, 8–18 cm. long; middle leaves lanceolate to ovate-oblong, 3–6 cm. long, 5–15 mm. broad; cymes small, numerous, not forked, at anthesis 1–2 cm. broad, later elongating and becoming 5–12 cm. long, terminal on stem and branches and on peduncles 1–4 cm. long arising from the uppermost leaf-axils; calyx 6–9 mm. long, lobes slender, 0.5–1 mm. broad, pedicels 2–4 mm. long at anthesis later becoming 5–15 mm. long; corolla in the bud asymmetric, its tip strongly curving; corolla at anthesis white or violet, obscurely bilabiate, 8.5–10 mm. long, from a short subcylindric tube 1.5–2 mm. thick and 2–3 mm. long expanding into a throat becoming 3.5–5 mm. thick just below the sinus, outer surface antrorsely strigulose, inner surface with a vertical line of hairs below each lobe, throat infolded below each sinus and hence with 5 broad rounded ribs; lobes triangular, 2 mm. broad and 1.5 mm. long; anthers 7–9 mm. long, firmly united into a tube, with a prolonged curved tip, attached 1.5 mm. above base, sterile tip 2.5–3 mm. long, bases held 1–1.5 mm. below level of corolla-sinus; filaments subulate, glabrous, 5–6 mm. long, affixed 2.5–3.5 mm. above corolla-base, decurrent base as much as 1.5 mm. long; nectary narrow, lobed, 0.1–0.2 mm. high, villose; style 15–18 mm. long, glabrous; nutlets 3 mm. long, dull, tuberculate, pitted.

YUNNAN: mouth of Dou-tschu, valley of Yangtze [southwest of Chungtien], lat. 27°46', 1650 m., fl. sordide violacei, *Handel-Mazzetti* 7595 (Ed); Fengkou Valley, lat. 27°40' [Yangtze bend], dry rocky place, 9000 ft., plant 1–2 ft., fl. white, *Forrest* 12807 (Ed).

SIKANG: Mekong Gorge below Ya-ka-la, about lat. 29°, near Tibet-Yunnan borders, dry slate rocks in gorge, 9000 ft., fl. cream, anthers "state blue," 1922, *Ward* 5362 in pt. (Ed).

- 16A. *Onosma multiramosum* var. *mekongense*, var. nov.

A varietate genuina differt faucibus corollae glabris; nectario sparse inconspicue villuloso.

YUNNAN: Mekong Valley [probably lat. 27°–29°], arid region, 8000 ft., 1913, *Ward* 492 (TYPE, Edinburgh).

A most unusual feature of this plant is its clearly zygomorphic corollas. From the herbarium material available it has been impossible to determine

the orientation of the parts with complete certainty. It appears, however, that the adaxial side of the corolla is most prolonged. In the bud the distal third of the tightly folded corolla is decidedly bent or curved away from the axis of the cyme. On pendulous portions of the cyme this causes the bud-tips to be directed upwards. Later, however, when the cyme straightens, the curve or bend in the bud is downward. In open flowers borne on an erect axis it is the upper side of the corolla that is slightly but still very definitely more elongate than the lower. The zygomorphy of the corolla, however, is most obviously displayed in the anthers. These are well exerted and have their prolonged united sterile tips very noticeably decurved.

17. *Onosma adenopus*, sp. nov.

Planta perennis cinerea; caulibus solitariis vel pluribus e caudice laxo fruticoso orientibus 1–4 dm. longis, basim versus 2–3 mm. crassis, erectis vel adscendentibus, simplicibus vel apicem versus pedunculos axillares 1–3 cm. longos gracilis proferentibus, hispidis vel hispido-villosis (pilis 1–3 mm. longis, patentibus, basi inconspicue incrassatis) et strigulosis (pilulis 0.1–0.3 mm. longis retrorsis); foliis numerosis firmis enervatis, supra hispidis vel hispido-villosis (pilis adscendentibus 1–2 mm. longis basi discoidea orientibus) et villulosis (pilulis 0.1–0.3), subtus hispidis et villulosis; foliis basalibus oblanceolatis 1–4 cm. longis 2–6 mm. latis rosulatis; foliis caulinis medionalibus 1.5–4 cm. longis 2–12 mm. latis lanceolatis vel oblongis basi rotundis; cymis sub anthesi 1–2 cm. latis, maturitate elongatis 3–5 cm. longis; calyce 5–7 mm. longo, lobis gracilibus 0.5–1 mm. latis, pedicello 2–8 mm. longo; corolla violacea vel purpurea 8.5–9.5 mm. longa a basi 1.5 mm. crassa primo leviter deinde (1.5–2 mm. supra basim) validioriter ampliata, sub sinus 3.5–5 mm. crassa, supra medium infra sinus verticaliter plicata, extus praesertim in lobis antrorse minuteque strigulosis, intus supra medium secus nervos sparse strigosa; lobis 2–2.5 mm. longis 1.5 mm. latis erectis; antheris 6.5–7.5 mm. longis basaliter lateraliterque cohaerentibus exsertis tubum formantibus, 1–1.5 mm. supra basim affixis, apicibus sterilibus 2–3 mm. longis rectis, basibus ca. 2 mm. infra sinus corollae positis; filamentis 5–5.5 mm. longis subulatis e areola glandulifera minute papillata 1.5–2.5 mm. supra basim corollae orientibus, basim versus minute papillatis, basi haud decurrentibus; nectario ca. 0.1 mm. alto glaberrimo haud vel vix lobulato; stylo 9–17 mm. longo glabro; nuculis 2–3 mm. longis pallidis minute abundanterque papillatis et sparse tuberculatis.

CHINA (Sikang): Kon-ka-ling, Aug. 1937, T. T. Yü 12909 (TYPE, Gray Herb.); Mekong Gorge, near Ya-ka-la, ca. lat. 29°, near Tibet-Yunnan border, young flowers pink, later turning bright violet, 1000 ft., Ward 5363 (Ed); Dzer-nar, Tsa-wa-rung, 3200 m., oak bushes on dry sandy south exposure, fl. purple, 1935, C. W. Wang 66520 (G); Shiangcheng, Sangbiling, 1937, T. T. Yü 13370 (G).

A very well marked species probably most closely related to *O. multiramosum*. It is distinguished from all other congeners, at least in our area,

by having the base of the filament, as well as a small area on the corolla immediately surrounding it, glanduliferous and studded with papillae. The papillate areas on the corolla from which each filament arises are elliptic in outline and about 2 mm. broad. On the outside of the corolla their position is marked by a slight depression of similar size and shape. From *O. multiramosum* our species is also distinguished by having the less prolonged tip of the staminal tube straight rather than curved, as well as by having a completely glabrous rather than a villose nectary. Additional characters distinguishing it are found in its subsimple stems and in the more slender bristles on stems and leaves.

18. *Onosma album* W. W. Smith & J. F. Jeff. Notes R. Bot. Gard. Edinburgh 9: 112 (1916).—Type from Yung-pi Mts., Yunnan, *Forrest 11188*.

Plant 6 dm. tall, probably perennial; stem single, erect, 4–6 mm. thick towards base, bearing numerous pedunculate cymes from the axils above the middle, bristly (hairs 1–3 mm. long, spreading, with thickened base) and strigulose (hairs abundant, 0.1–0.3 mm. long, mostly retrorse); leaves veinless, above green, hispid, lower surface pale, densely strigulose and sparsely hispid; basal leaves mostly dried up at time of flowering, oblanceolate, 5–8 cm. long, 4–5 mm. broad, acute; middle stem-leaves lanceolate, 4–5 cm. long, 5–8 mm. broad, apex acute, base acute to rounded; cymes numerous, 1–4 cm. broad at anthesis, mostly simple, terminal on stem and on slender peducles 3–8 cm. long from upper axils, hence displayed in a loose elongate paniculate arrangement; calyx 10–13 mm. long, lobes lance-linear, pedicels slender, 5–20 mm. long; corolla pure white, 12.5–14 mm. long, from a base 2 mm. thick expanding and becoming 6–7 mm. broad just below the sinus, outside abundantly antrorse-strigulose, inside with hairs below the lobes and on nectary and decurrent base of filament; anthers 9.5–10 mm. long, coherent to form a tube, well exerted, affixed 2 mm. above base, sterile tips 2–3 mm. long, bases carried about 3 mm. below level of corolla-sinus; filaments 6–7 mm. long, arising 2.5–4 mm. above corolla-base, decurrent base 2–3 mm. long, bearing a few hairs towards its lower end; nectary very narrow, interrupted, villose, ca. 0.1 mm. high; style 14–20 mm. long, bearing some appressed hairs below the middle; nutlets not seen.

YUNNAN: on the Yung-pi Mts., lat. 26°45', plant 2 ft., fl. pure white, open dry stony pasture, 10000 ft., Sept. 1913, *Forrest 11188* (Ed, TYPE).

A plant much resembling *O. confertum* in all save flowers. It differs in having a white corolla hairy in the throat, lobes less strongly recurved, anthers protruding, style hairy, and the decurrent base of the filaments unthickened.

(To be concluded)

STUDIES OF PACIFIC ISLAND PLANTS, IX NOTES ON THE RUTACEAE OF FIJI, SAMOA, AND TONGA

A. C. SMITH

IDENTIFICATION OF THE SPECIMENS of Rutaceae recently obtained in Fiji by the writer¹ proved so difficult that a regional revision of the genera with dehiscent fruits seemed desirable. The species from Samoa, Tonga, and Niue are considered as well as those from Fiji. For the purposes of this study, the collections of the group in various herbaria have been examined, the place of deposit of specimens being indicated in this paper as follows: Arnold Arboretum (A); Bernice P. Bishop Museum (Bish); British Museum (BM); DePauw University (DP); Gray Herbarium (GH); Royal Botanic Gardens, Kew (K); New York Botanical Garden (NY); University of California (UC); and U. S. National Herbarium (US). I am much indebted to the authorities of these institutions for the privilege of examining specimens under their care.

The subfamily Aurantioideae is not considered in this treatment, since the indigenous species of this subfamily in our region are only two. *Micromelum minutum* (Forst. f.) Seem. is abundant throughout; it is a fairly variable species in indument, and Seemann takes it to include *M. glabrescens* Benth., described from Tonga. *Wenzelia kambarae* Swingle (in Jour. Arnold Arb. 21: 12. 1940) is apparently limited to the Lau Group in Fiji. Otherwise, the subfamily is represented in our region only by the several species or varieties of *Citrus* which have become more or less naturalized; for a consideration of the Aurantioideae the reader is referred to W. T. Swingle's treatment in Webber, H. J., and L. D. Batchelor, *The Citrus Industry* 1: 129-474. 1944.

The difficulties inherent in generic delimitation in the Rutaceae are well known, but most students are satisfied to follow Engler's treatment of the family (in Nat. Pfl. ed. 2. 19a: 187-359. 1931). It may, indeed, be a very long time before that critical treatment is supplanted by anything in the nature of an improvement. Some problems relating to the *Evodia-Melicope-Acronychia* group of genera are briefly considered for Papuasias by Merrill and Perry (in Jour. Arnold Arb. 22: 32-59. 1941). Specimens from Fiji and the adjacent archipelagos belonging to these three genera can usually be placed without difficulty if good material is available, but whether or not the currently accepted generic limits are natural can be decided only after exhaustive study by a monographer.

¹ Under the auspices of the Arnold Arboretum of Harvard University and the John Simon Guggenheim Memorial Foundation, with the aid of grants from the Penrose Fund of the American Philosophical Society and the Bache Fund of the National Academy of Sciences.

In the region under consideration there are now recognizable 23 species of dehiscent-fruited Rutaceae; of these I describe eight species and two varieties as new, while two new combinations are made. A greatly simplified key to the four genera concerned follows:

- Leaves alternate, pinnate, with 2-8 pairs of lateral leaflets (in our species);
 stamens 4.....1. *Fagara*.
 Leaves (in our species) prevailing opposite, 1- or 3-foliolate.
 Stamens 4; ovary deeply 4-lobed, the carpels essentially free in fruit.....
2. *Evodia*.
 Stamens 8 (in our species).
 Ovary shallowly lobed, the lobes firmly connate even in fruit.....
3. *Acronychia*.
 Ovary with free carpels, these united in flower by the styles, divergent
 in fruit.....4. *Melicope*.

1. FAGARA L.

The species of this alliance in our region belong to *Fagara* rather than *Xanthoxylum*, following the interpretation of Engler (in Nat. Pfl. ed. 2. 19a: 214-224. 1931). The confused generic nomenclature of these groups has been remarked by Reeder and Cheo (in Jour. Arnold Arb. 32: 67. 1951), whose use of the names follows most current procedure. The species discussed below fall into Engler's section *Blackburnia*.

Individual plants of *Fagara* appear to be very rare in Fiji and Tonga and lacking in Samoa. Until 1936 the genus had not been recorded from Fiji, but at that time I noted the occurrence of two species (in Bishop Mus. Bull. 141: 76-77, as *Zanthoxylum*). It now appears that four species of the group occur in Fiji, one of them extending into Tonga.

KEY TO THE SPECIES

- Leaflets 2-5 pairs, the blades entire or essentially so, obviously inequilateral at base; flowers and fruits distinctly pedicellate.
 Leaves usually 10-27 cm. long, the petiole (2-)3-5 cm. long; leaflet-blades chartaceous, more or less translucent when dried, the venation obvious on both surfaces, the margin nearly plane.....1. *F. pinnata*.
 Leaves 8-13 cm. long, the petiole 1.5-3 cm. long; leaflet-blades coriaceous, opaque, with less obvious venation, strongly revolute at margin.....
2. *F. gillespieana*.
 Leaflets 6-8 pairs, the blades crenulate at margin, the indentations marked by glands, the base only slightly inequilateral; flowers sessile in ultimate clusters of 2 or 3.
 Leaves 25-30 cm. long, the petiole (2-3 cm. long) and rachis obviously canaliculate; leaflet-blades 5-7 × 2-3 cm.....3. *F. vitiensis*.
 Leaves 40-50 cm. long, the petiole (10-12 cm. long) and rachis subterete; leaflet-blades 11-15 × 4-5 cm.....4. *F. myriantha*.

1. ***Fagara pinnata*** (J. R. & G. Forst.) Engl. in Nat. Pfl. III. 4: 119. 1896, ed. 2. 19a: 224. 1931.

Blackburnia pinnata J. R. & G. Forst. Char. Gen. pl. 6. 1776; Forst. f. Fl. Ins. Austr. Prodr. 10. 1786.

Ptelea pinnata L. f. Suppl. 126. 1781.

Zanthoxylum blackburnia Benth. Fl. Austral. 1: 363. 1863; Burkill in Jour. Linn. Soc. Bot. 35: 30. 1901.

Zanthoxylum pinnatum Druce in Rep. Bot. Exch. Club Brit. Isles 1916: 653. 1917; A. C. Sm. in Bishop Mus. Bull. 141: 76. 1936.

DISTRIBUTION: Norfolk Island (type locality) to Fiji and Tonga; probably also in Australia, but the New Caledonian plants so referred may not belong here.

FIJI: FULANGA: In forest on limestone formation, alt. 0-80 m., *Smith 1150* (Bish, GH, K, NY, UC, US) (*warui*; tree 12 m. high; petals white; anthers yellow).

TONGA: *Harvey* (K). VAVAU: *Crosby* (K); Talau hill, alt. 120 m., *MacDaniels 1093* (Bish) (tree 12 m. high, the trunk 25 cm. in diameter).

It may be suspected that this entity has been too broadly interpreted. The Forsters' type (BM) from Norfolk Island was not re-examined in connection with the present study, but in 1936 I was apparently satisfied that the material from Tonga and Fiji agreed with the type. The range and variation of the Forsters' species should be studied by a monographer of the group.

2. *Fagara gillespieana* sp. nov.

Arbor ad 20 m. alta sub fructu ubique glabra, ramulis validis teretibus cinereis, foliis inflorescentiisque apices ramulorum versus congestis; foliis 8-13 cm. longis, petiolo 1.5-3 cm. longo subtereti vel semitereti basi incrassato, rhachi gracili leviter canaliculata; foliolis 2-4 (raro 5)-jugis oppositis, petiolulis gracilibus canaliculatis 4-8 mm. longis, laminis coriaceis opacis in sicco fusco-viridibus ovato-oblongis, plerumque 4-5.5 cm. longis et 2-3 cm. latis, basi inaequilateraliter obtusis, apice obtuse et breviter cuspidatis, margine integris anguste sed valde revolutis, supra subnitidis, costa supra impressa subtus prominente, nervis secundariis utrinsecus 6-8 supra paullo subtus manifeste elevatis, rete venularum utrinque subprominulo vel supra immerso; inflorescentiis sub anthesi non visis, sub fructu inter folia patentibus 5-9 cm. longis pauciramosis, pedunculo brevi et ramulis gracilibus subteretibus in sicco rugulosis, bracteis caducis, pedicellis subteretibus 2.5-6 mm. longis, calyce circiter 2 mm. diametro, lobis 4 persistentibus minutis deltoideis obtusis; fructibus ellipsoideis maturitate ad 14 mm. longis et 11 mm. latis, utroque rotundatis, pericarpio coriaceo valde ruguloso, semine ad 11 × 9 mm. nitido ut videtur nigro.

FIJI: VITI LEVU: Mba: Summit ridge of Mt. Nanggaranambuluta [Lomalangi], east of Nandarivatu, alt. about 1100 m., *Gillespie 3943* (Bish, GH, UC); Nandronga & Navosa: Northern portion of Rairaimatuku Plateau, between Nandrau and Nanga, alt. 725-825 m., Aug. 7, 1947, *Smith 5578* (A TYPE, US) (*totowivi*; tree 20 m. high, in dense forest).

Both cited specimens bear essentially mature fruits, but they seem indubitably closely allied to the preceding species, *F. pinnata*. The smaller, shorter petiolate leaves and the coriaceous leaflet-blades, which

are opaque, with comparatively obscure nerves and strongly revolute margins, seem adequately to differentiate *F. gillespieana* from its lowland relative.

3. *Fagara vitiensis* (A. C. Sm.) comb. nov.

Zanthoxylum vitiense A. C. Sm. in Bishop Mus. Bull. 141: 77. fig. 38. 1936.

DISTRIBUTION: Known only from the type collection.

FIJI: VANUA LEVU: Thakaundrove: Eastern buttress of Mt. Ndikeya, alt. 800 m., *Smith 1884* (Bish TYPE, K, NY, US) (slender tree 3 m. high, in crest thickets; petals and filaments white; anthers yellow).

This well-marked species is readily distinguished from *F. pinnata* by its more numerous leaflets with crenulate margins and by its sessile flowers; the new species described below is a closer ally. *Fagara vitiensis* is monoecious, but in the original description I failed to note the pistillate inflorescences, which are here described:

Pistillate inflorescences subterminal, similar to ♂ but perhaps with fewer flowers; flowers slightly more slender than the ♂ but with a similar perianth; staminodes 4, reduced to very minute brownish scales at base of gynaecium; gynaecium at anthesis about 2.5 mm. long, the ovary on a short conical gynophore, thick-walled, unilocular, the ovules 2, collateral, dependent, the style terete, very short, the stigma subcapitate, about 0.6 mm. in diameter.

4. *Fagara myriantha* sp. nov.

Arbor ad 15 m. alta, ramulis validis teretibus fuscis rugulosis primo obscure puberulis mox glabratis; foliis apices ramulorum versus aggregatis, 45–50 cm. longis, ad 30 cm. latis, ubique glabris, petiolo 10–12 cm. longo et rhachi pro magnitudine folii gracilibus subteretibus vel supra inconspicue complanatis; foliolis 6–8-jugis oppositis, petiolulis leviter canaliculatis gracilibus 7–10 mm. longis, laminis chartaceis opacis in sicco fusco-viridibus lanceolato-oblongis, imis 7–9 cm. longis et 3–4.5 cm. latis, superioribus 11–15 cm. longis et 4–5 cm. latis, basi late obtusis et leviter inaequalibus, superne in acuminem obtusum ad 1 cm. longum gradatim angustatis, margine conspicue crenatis (crenaturis 1 vel 2 per centimetrum, sinibus manifeste glanduloso-punctatis), costa supra subplana vel leviter impressa subtus prominente, nervis secundariis utrinsecus 10–14 supra subplanis subtus acute elevatis, rete venularum supra obscuro subtus haud prominulo; inflorescentiis ♂ solis visis subterminalibus vel apices ramulorum versus axillaribus pyramidali-thyrsoideis multiramosis multifloris, 20–30 cm. longis et ad 15 cm. latis, breviter pedunculatis, rhachi crassa (basim versus 4–5 mm. diametro) subtereti primo cum ramis minute puberulis demum glabratis, ramis lateralibus 10–15 superne dichotome ramulosis, bracteis ovato-oblongis obtusis circiter 1 mm. longis; floribus sessilibus binis vel ternatis, bracteolis sub floribus oppositis circiter 0.5 mm. longis; calyce sub anthesi circiter 3 mm. diametro primo obscure puberulo mox glabrato, lobis 4 patentibus subcarnosis ovatis obtusis, 1–1.2 mm. longis

et 1.3–1.7 mm. latis; petalis 4 subcarnosis glabris obovato-oblongis, 4–4.5 mm. longis, 1.5–2 mm. latis, apice rotundatis; staminibus erectis, filamentis crassis 2–2.5 mm. longis, antheris ellipsoideis circiter 2 mm. longis apice minute mucronulatis; disco subnullo; ovarii rudimento subgloboso circiter 0.8 mm. diametro in stylum minutum angustato.

FIJI: VANUA LEVU: Mathuata: Southern base of Mathuata Range, north of Natua, alt. 100–250 m., Dec. 1, 1947, *Smith 6769* (A TYPE, US) (tree 15 m. high, in dense forest, the trunk about 15 cm. in diameter; petals and filaments white; anthers yellow).

The new species is striking for its very large leaves and ample inflorescences; it is closely related to the preceding, *F. vitiensis*, differing in the obvious vegetative characters mentioned in my key. In ♂ flowers the two species are nearly identical, *F. myriantha* having slightly broader calyx-lobes, shorter petals, and longer anthers than its ally, on the basis of the only collections now available.

Fagara myriantha is somewhat suggestive of Solomon Islands plants which have been referred to *Fagara rhetsa* Roxb., such as *Walker & White 126* (K) from Guadalcanal. Other material from the Solomons was referred to this species by Merrill and Perry (in *Jour. Arnold Arb.* 22: 33. 1941, as *Zanthoxylum rhetsa* (Roxb.) DC.). Regardless of the identity of such specimens with *Fagara rhetsa*, the Fijian collection cannot be taken to represent the species as illustrated by Koorders and Valetton (*Atlas Baumart. Java 2: fig. 352. 1914*), which is shown as having quite entire leaflets.

2. EVODIA J. R. & G. Forst.

The genus *Evodia*, although apparently not represented by many species in our region, is a common element of the vegetation in Fiji at all elevations and in many habitats. In Tonga the genus is represented only by the presumably introduced *E. hortensis*, and in Samoa by this common species and one endemic, *E. samoensis*. A satisfactory classification within the genus, in our region, is difficult, because of the elusiveness of usable taxonomic characters. Current herbarium identifications are not very helpful, and frequent use of the binomial *E. roxburghiana* for various forms (in both *Evodia* and *Acronychia*) has complicated matters. This binomial, in the sense of its type (*Zanthoxylum roxburghianum* Cham.), is considered to be a synonym of *Evodia lunur-ankenda* (Gaertn.) Merr. (see Merrill in *Philip. Jour. Sci. Bot.* 7: 373–378. 1912, for a very informative discussion of the complex synonymy of this and other confused entities). Christophersen (in *Bishop Mus. Bull.* 154: 14. 1938) expressed the opinion that *E. lunur-ankenda* does not occur in Samoa; Merrill gives its range as India to the Malay Peninsula, Sumatra, and Java, and its occurrence in our region may be definitely discounted.

The most satisfactory—although minute—characters for differentiating our species lie in the disk. In three species (*E. samoensis*, *E. hortensis*, and *E. capillacea*), the disk is strictly glabrous and in pistillate

flowers forms a cup subtending the gynaecium; these species are readily distinguished from one another and do not present serious difficulties. Three other species, *E. cucullata* and two here described as new, have the disk copiously hispidulous-tomentellous, merely pulvinate and forming a minute gynophore in the pistillate flowers. This group of entities, endemic to Fiji, is taxonomically difficult, and the solution presented below, in which foliage characters are emphasized as the only tangible criteria, is not entirely satisfactory. Another Fijian species, *E. seemannii*, has the disk pulvinate and faintly puberulent, appearing glabrous except under high magnification; although intermediate in disk-characters, it is a readily recognized species.

In our region seven species of *Evodia* are believed discernible, three of them being further divided. Two species and two varieties are here proposed as new.

KEY TO THE SPECIES

Disk (in both ♂ and ♀ flowers) glabrous, in ♀ flowers pulvinate-cupuliform, the margin slightly upcurved and extending laterally beyond base of gynaecium.

Ovules 2 in each ovary-lobe; inflorescence comparatively large and many-flowered.

Leaves 3-foliolate, the petiole 6–18 cm. long, the leaflet-blades usually lanceolate, 9–22 × 4–11 cm., gradually acuminate at apex; young parts copiously puberulent-tomentellous; inflorescence broadly paniculate, 4–18 cm. long and nearly as broad; pedicels about 1 mm. long; style (in ♀ flowers) 2.5–3 mm. long; ovary-lobes glabrous or very sparsely hispidulous, free but closely appressed to each other; Samoa.....1. *E. samoensis*.

Leaves 1- or 3-foliolate, the petiole 1–7 cm. long, the leaflet-blades not exceeding 6.5 cm. in breadth; inflorescence obviously longer than broad; style (in ♀ flowers) not exceeding 2 mm. in length.

Leaflet-blades very diverse in shape, obtuse to short-acuminate at apex; young parts minutely sericeous; inflorescence narrowly paniculate, 7–30 cm. long, 1–5 (rarely 10) cm. broad; pedicels at anthesis 2–3 mm. long; style less than 1 mm. long; ovary-lobes glabrous, obviously separate; widespread species in cultivation or naturalized.....2. *E. hortensis*.

Leaflet-blades lanceolate, 7–17 × 1.5–5 cm., gradually narrowed to an acuminate apex; young parts obscurely puberulent, soon essentially glabrate; inflorescence paniculate, 4–12 cm. long, about half as broad as long; pedicels at anthesis less than 2 mm. long; style (in ♀ flowers) about 2 mm. long; ovary-lobes copiously but minutely puberulent, free but appressed to each other; Fiji.. ..4. *E. seemannii*.

Ovule single in each ovary-lobe; inflorescence comparatively few-flowered, 1–8 cm. long, the pedicels 2–4 mm. long; leaves small, 1- or 3-foliolate, the petiole 1–3.5 cm. long, the leaflet-blades lanceolate or ovate-lanceolate, 4–11 × 1.3–5.5 cm.; Fiji.....3. *E. capillacea*.

Disk (in both ♂ and ♀ flowers) hispidulous or tomentellous or puberulent, in ♀ flowers pulvinate, the margin not upcurved and hardly extending laterally beyond base of gynaecium; ovules 2 in each ovary-lobe; leaves 3-foliolate (very rarely 1-foliolate); Fijian species.

Indument of disk scarcely apparent, the hairs visible only with high magnification; ovary-lobes copiously but minutely puberulent; leaflet-blades lanceolate, $7-17 \times 1.5-5$ cm., acuminate at apex.....4. *E. seemannii*.

Indument of disk obvious, the hairs at least 0.1 mm. long.

Fruiting carpels strigillose-puberulent (hairs rarely obscuring the surface), usually essentially glabrate at maturity; leaflet-blades glabrous or inconspicuously puberulent on costa and secondaries beneath (hairs not more than 0.2 mm. long).

Leaflet-blades obovate or elliptic-obovate, sometimes elliptic, not exceeding 13.5×7 cm., usually considerably smaller, retuse at the rounded or broadly obtuse apex.....5. *E. cucullata*.

Leaflet-blades elliptic or oblong-elliptic, usually $6-20 \times 3-11$ cm., acuminate or cuspidate at apex (actual apex callose-tipped to rounded or faintly emarginate).....6. *E. vitiensis*.

Fruiting carpels very copiously and persistently hispidulous-puberulent (hairs pale, 0.1-0.2 mm. long); leaflet-blades lanceolate to ovate-lanceolate, $6-12 \times 2.5-5.5$ cm., gradually acuminate or cuspidate at apex and callose-tipped, hispidulous-tomentellous along costa and secondaries beneath (hairs pale, about 1 mm. long, usually persistent).....7. *E. evansensis*.

1. *Evodia samoensis* Christophersen in Bishop Mus. Bull. 154: 12. fig. 3, as *Euodia* s. 1938.

Evodia roxburghiana sensu Reinecke in Bot. Jahrb. 25: 642. 1898; Rechinger in Denkschr. Akad. Wiss. Wien 85: 294. 1910; non Benth.

DISTRIBUTION: Endemic to Samoa, where it is to be expected on most of the islands. It most frequently occurs in open forest, at elevations of 75-550 m., being recorded as a tree of medium height (4-17 m. high), with greenish flowers. Recorded local names are *soopeni* (by Garber) and *fua pini* (by Reinecke); Christophersen comments that the first of these may be a misspelling of *so'opini*.

SAMOA: SAVAI: *Vaupel* 221 (Feb. 16, 1906, NY, US) (Apr. 24, 1906, Bish); near Vaipouli, *Christophersen & Hume* 1846 (Bish). UPOLU: *Reinecke* 287 (Bish, BM, K, US); near Malololelei, *Christophersen* 143 (Bish TYPE), *Wilder* 419 (Bish). OFU: *Yuncker* 9448 (Bish). OLOSENGA: Piumafua Mt., *Garber* 1026 (Bish). TAU: Amouli trail, *Garber* 617 (Bish, US); above Siufaga, *Yuncker* 9193 (Bish). Samoa, without definite locality: *Whitmee* (GH).

This very distinct species has no close allies in our region, where it might be confused only with the Fijian species described below as *E. vitiensis*; from this, however, the glabrous disk and its different shape in pistillate flowers readily distinguish *E. samoensis*. In sterile condition *E. samoensis* can be mistaken for *Acronychia heterophylla*, although the two species differ in degree of indument on the young parts and in details of leaflet-shape and venation.

2. *Evodia hortensis* J. R. & G. Forst. Char. Gen. Pl. 14. *pl.* 7, as *Euodia h.* 1776.

DISTRIBUTION: Widespread in the Pacific and perhaps not native in our region. It is usually noted in cultivation or as an escape, rarely being found naturalized in more or less disturbed areas. In Fiji I have seen no indication that it is indigenous. It is commonly noted as a shrub or tree, usually less than 5 m. in height, at low elevations except where cultivated in hill villages. The flowers have white petals and a yellow disk, the fruits being green to light brown. Both foliage and inflorescences are strongly scented and pungent, the fragrance being often mentioned as "unpleasant" by collectors but apparently agreeable to natives of the region. The plant has a variety of uses in medicine (leaves chewed as a remedy for toothache and stomach pains, a remedial bath prepared from crushed leaves, a medicinal tea made from leaves, etc.) and ornamentation (inflorescences used to scent coconut oil). Local names are: *uthi*, *rauuvula* (in Fiji); *usi*, *lau usi*, *usi-ulu* (in Samoa); *ohe*, *uhi* (in Tonga and Niue).

The Forsters' specimens of the species, from Tonga, include parts of both forms found in our region, with wide and narrow leaflets. The form with comparatively wide leaflets has been taken as typical by Lauterbach (in Bot. Jahrb. 55: 231. 1918) and others who have used such a concept. Lauterbach's var. *typica* is made superfluous by recent nomenclatural legislation requiring repetition of the specific epithet for any type-including subdivision.

The two forms have essentially the same distribution, and the same local names and uses are accredited to both. Floral characters appear to be remarkably uniform throughout the species, but the leaves of the two forms are usually strikingly different. That some individuals bear both broad and narrow leaflets, as sometimes asserted (e. g. Seemann, Fl. Vit. 31. 1865), I am inclined to doubt, but it is true that leaf-form is very flexible in the species. Therefore the two elements of the population seem to merit recognition as forms rather than as varieties. They may be distinguished as follows:

- Leaves 1- or 3-foliolate, the leaflet-blades usually 4-5 times as long as broad,
7-24 × (2-)2.5-6 cm., with 6-10(-14) curved-ascending lateral nerves.
.....2a. f. *hortensis*.
- Leaves 1-foliolate, the leaflet-blades usually 9-15 times as long as broad,
10-30 × 0.8-2.5 cm., with 15-30 or more short spreading lateral nerves.
.....2b. f. *simplicifolia*.

2a. *Evodia hortensis* f. *hortensis*.

Evodia hortensis J. R. & G. Forst. Char. Gen. Pl. 14. *pl.* 7, as *Euodia h.* 1776; DC. Prodr. 1: 724. 1824; A. Gray, Bot. U. S. Expl. Exped. 1: 332. 1854; Seem. Fl. Vit. 30. 1865; Hemsl. in Jour. Linn. Soc. Bot. 30: 171. 1894; Reinecke in Bot. Jahrb. 25: 642. 1898; Burkill in Jour. Linn. Soc. Bot. 35: 30. 1901; Rechinger in Denkschr. Akad. Wiss. Wien 85: 293. 1910; Setchell in Carnegie Inst. Publ. 341: 87. 1924; Christophersen in Bishop Mus. Bull. 128: 106. 1935.

Fagara euodia L. f. Suppl. 125. 1781; Murr. Syst. Veg. 160, as *F. evodia*. 1784.

Zanthoxylum varians Benth. in Hook. Lond. Jour. Bot. 2: 214. 1843.

Evodia hortensis var. *typica* Lauterb. in Bot. Jahrb. 55: 231. 1918.

FIJI: VITI LEVU: Seemann 91 (GH, K); Mba: Nalotawa, eastern base of Mt. Evans Range, Smith 4329 (A, US); Nandronga & Navosa: Near Singatoka River, Greenwood 832 (A, K, NY, US); Mbelo, near Vatukarasa, Degener 15325 (A, Bish, K, NY, UC, US); Tunuve, Bemana district, H. B. R. Parham 183 (BM); Rewa: Nukulau Island, H. B. R. Parham 10 (BM). OVALAU: Milne 255 (K); Levuka, Prince (GH), Gillespie 4560 (Bish, GH, K, NY, UC, US). KANDAVU: Namalata Isthmus region, Smith 6 (Bish, GH, K, NY, UC, US). VANUA LEVU: Mathuata: Undu Point, Tothill 52b (K); Thakaundrove: Savu Savu Bay region, Degener & Ordenez 13863 (A, Bish, K, NY, UC, US); Maravu, near Salt Lake, Degener & Ordenez 14131 (A, Bish, K, NY, UC, US). VANUA MBALAVU: Nambavatu, Tothill 52 (K). MOALA: Naroi, Smith 1404 (Bish, GH, K, NY, UC, US). MATUKU: Bryan 256 (Bish). Fiji, without definite locality: Hinds & Barclay (K type of *Zanthoxylum varians*), U. S. Expl. Exped. (GH, NY), Harvey (GH, K), Horne (GH).

SAMOA: SAVAI: Matautu, Vaupel 241 (Bish, K, US); Manase plantation, Christophersen 674 (Bish, K, NY, US), Christophersen & Hume 1979 (Bish, K, NY, UC, US). UPOLU: Vaea, Bryan 98 (Bish); near Apia, Reinecke 210 (Bish, K, US), Eames 153 (Bish, UC); Vaiele, Eames 167 (Bish). TUTUILA: Papatele trail, Setchell 268 (UC); near Pago Pago, Garber 931 (Bish, K, NY). Samoa, without definite locality: U. S. Expl. Exped. (NY, US), Powell (K), 287 (GH, K), 303 (K), Whitmee 39 (K).

TONGA: VAVAU: Moore 499 (K); near Talau hill, MacDaniels 1100 (Bish). VAVAU and LIFUKA: Harvey in part (K). TONGATABU: Near Kologa, Setchell & Parks 15361 (Bish, K, UC, US). Tonga, without definite locality: J. R. & G. Forster (BM TYPE, K in part), Harvey in part (K), Crosby in part (K).

2b. *Evodia hortensis* f. *simplicifolia* (Rechinger) K. Schum. ex Lauterb. in Bot. Jahrb. 55: 232. 1918; Christophersen in Bishop Mus. Bull. 128: 106, as *Euodia h. f. s.* 1935; Yuncker in Bishop Mus. Bull. 178: 67. 1943.

Euodia longifolia A. Rich.; A. Gray, Bot. U. S. Expl. Exped. 1: 332. 1854; Seem. in Jour. Bot. 2: 71, as *Evodia l.* 1864.

Evodia hortensis var. *simplicifolia* Rechinger in Denkschr. Akad. Wiss. Wien 85: 294. 1910; Setchell in Carnegie Inst. Publ. 341: 87. 1924.

TYPE LOCALITY: As type of his variety, Rechinger indicates his no. 3735, from Vaipouli, Savaii, Samoa. Although I have not seen this collection, it obviously represents the narrow-leaved form of the species. Lauterbach's discussion of *E. hortensis* (in 1918) is confusing, and one cannot be sure that his f. *simplicifolia* is intended to be based upon Rechinger's var. *simplicifolia*. I follow Christophersen and Yuncker in their interpretation of the trinomial as a new combination.

FIJI: TAVEUNI: Somosomo, Seemann 92 (GH, K). MOALA: Naroi, Smith 1403 (Bish, GH, K, NY, UC, US). Fiji, without definite locality: U. S. Expl. Exped. (GH), Milne 152 (K), Graeffe (K).

SAMOA: SAVAI: Saipipi, Christophersen 923 (Bish); near Safune, Christophersen & Hume 2434 (Bish, K, NY, UC, US). TUTUILA: "From

J. G. Veitch" (K); Utomea, near Leone, *Setchell* (coll. *Collarino*) 556 (Bish, UC); Pago Pago, *Wilder* 83 (Bish); Nu'uuli, *Garber* 960 (Bish); Aua, *Bryan* 964 (Bish). OFU: Near Ofu, *Yuncker* 9446 (Bish). Samoa, without definite locality: *U. S. Expl. Exped.* (GH, K, NY, US), *Powell* 303 (K), *Whitmee* 38 (K).

TONGA: VAVAU and LIFUKA: *Harvey* in part (K). TONGATABU: Near Nukualofa, *Setchell & Parks* 15175 (UC). EUA: *Lister* (K); plateau and Houma districts, *Parks* 16189 (Bish, GH, K, NY, UC, US). Tonga, without definite locality: *J. R. & G. Forster* in part (K), *Mathews* 123 (K), *Harvey* in part (K), *Crosby* in part (K), *McKern* 44 (Bish), 112 (Bish).

NIUE: Alofi, *Yuncker* 9819 (DP).

3. *Evodia capillacea* Gillespie in Bishop Mus. Bull. 91: 10. fig. 10. 1932.

DISTRIBUTION: Endemic to Fiji and thus far known only from Viti Levu and Taveuni at high elevation (950–1220 m., with the exception of *Degener* 15195, collected at 150 m.). The species seems to be a rare component of upland forest or dense crest thickets; it is a shrub or slender tree 3–5 m. in height. Color notes indicate that the petals are white or yellowish, sometimes pink-tinged without, the filaments white, the anthers and ovary pale yellow, the fruit purple-tinged, and the seed black. The only local name recorded (*Smith* 4992) is *velivelitambua*.

FIJI: VITI LEVU: Mba: Vicinity of Nandarivatu, along the Mba road, *Gillespie* 4046 (Bish TYPE, GH); ridge between Mt. Nanggaranambuluta [Lomalangi] and Mt. Namama, east of Nandarivatu, *Smith* 4992 (A, US); Serua: Vatutavathe, near Ngaloa, *Degener* 15195 (A, Bish, K, NY, UC, US); Namosi: Summit of Mt. Vakarongasiu, *Gillespie* 3259 (Bish, GH, UC). TAVEUNI: Summit of Mt. Uluingalau, *Smith* 892 (Bish, GH, K, NY, UC, US).

Evodia capillacea is a remarkable species for several reasons, being distinct from all other *Evodiae* in our region in having a single ovule ascending from the inner angle of each ovary-lobe, a fact clearly observed in each of the five available collections, all of which bear fertile ovaries. In the other species here discussed the ovules are always paired and superposed. It may be assumed that *E. capillacea* is polygamo-dioecious, although no strictly staminate flowers have been observed. *Gillespie* 3259 and *Degener* 15195 bear perfect flowers, with both ovaries and anthers clearly fertile; *Smith* 892 and 4992 (and presumably also the type) bear pistillate flowers, with anthers developed but apparently sterile. The species is further distinguished by its very much reduced, few-flowered inflorescences and its small leaves. The Viti Levu specimens have either predominantly 1-foliate leaves (*Gillespie* 3259, *Degener* 15195) or mixed 1- and 3-foliate leaves (*Gillespie* 4046, *Smith* 4992). The Taveuni specimen (*Smith* 892) has the leaves apparently always 3-foliate; this specimen further differs from the Viti Levu material in having the ovary strictly glabrous instead of hispidulous- or strigillose-puberulent. On the basis of available material I do not feel justified in proposing nomenclatural status for the Taveuni plant.

4. *Evodia seemannii* Gillespie in Bishop Mus. Bull. 91: 12. fig. 12, as *E. seemanni*. 1932.

Evodia drupacea sensu Seem. Fl. Vit. 30. 1865, p. p.; non Labill.

DISTRIBUTION: Endemic to Fiji and apparently uncommon, known only from Viti Levu and Vanua Levu, at altitudes from near sea-level (*Parham 166*) up to 1050 m. It has been noted as a shrub or slender tree 4–10 m. high, in dense forest or dry forest; the petals and filaments are cream-white. Recorded local names are *ndrautolu* and *tokatolu* (Viti Levu), and *salusalu rakalava* (Mbua).

FIJI: VITI LEVU: Mba: Slopes of Mt. Nairoso, eastern flank of Mt. Evans Range, *Smith 4022* (A, US); Nandarivatu, *Gillespie 3713* (Bish, UC); western slopes of Mt. Nanggaranambuluta [Lomalangi], east of Nandarivatu, *Greenwood 869* (A, K), *Smith 4769* (A, US); Naitasiri: Nanduruloulou, *B. E. Parham 166* (A). VANUA LEVU: Mbua: Southern portion of Seatovo Range, *Smith 1707* (Bish, GH, K, NY, UC, US); Mathuata: *Seemann 90* (GH TYPE, K).

This very distinct species is readily recognized by its usually 3-foliolate leaves, with lanceolate and acuminate leaflet-blades, by its very closely puberulent or glabrate young parts and inflorescences, and by the minute indument of its disk and ovary. In the available material, good flowers accompany the type, *Parham 166*, and *Smith 1707*; all flowers dissected are either pistillate or perfect, the anthers at least sometimes being obviously fertile.

In accordance with recent nomenclatural legislation, Gillespie's epithet *seemannii* is considered an orthographic variant which should be corrected to *seemannii*.

5. *Evodia cucullata* Gillespie in Bishop Mus. Bull. 91: 10. fig. 11. 1932.

In his original description of this entity, Gillespie cites eight of his own collections and also implies that it includes the Exploring Expedition collection which Gray referred to *E. drupacea*. Gillespie was aware that his concept as thus outlined was very broad, and he suspected that the larger-leaved specimens from Taveuni might not belong in the same species as typical material from Viti Levu. After study of a fairly extensive series of specimens, I must verify Gillespie's implication that the Fijian material of this immediate affinity is very uniform in floral and fruit characters. *Evodia cucullata*, in the broad sense accepted by its author, would have to be accepted, without regard for foliage characters, as the Fijian population of *Evodia* with a pulvinate and copiously hispidulous-tomentellous disk. The vegetative extremes of this population, however, are so diverse that I think they cannot conveniently be left in a single species. A few specimens (not known to Gillespie) from the isolated Mt. Evans Range of Viti Levu have copiously and persistently pilose carpels and usually conspicuous indument on the nerves of the lower surfaces of leaflets; this entity I describe below as *E. evansensis*. The (nomenclaturally) typical element of Gillespie's species is represented, among the specimens cited, by only nos. 3198 and 3743; this element

seems restricted to higher elevations (above 700 m.) on the larger islands. A lowland variant, with larger but similarly rounded and emarginate leaflets, is described below as var. *robustior*; this does not seem to occur above 500 m. altitude, and it is more often found near sea-level.

The rest of the population of this immediate alliance, with leaflets which are acuminate or cuspidate at apex, I describe as *E. vitiensis*. In its larger-leaved phase (var. *vitiensis*), this species is very different in foliage from *E. cucullata*, but a smaller-leaved variant (var. *minor*) resembles *E. cucullata* var. *robustior* in size (but not in apex) of leaflets. The division of this complex population into two species, each with two varieties, is not very satisfactory, since the elements here recognized may be inter-fertile. The typical forms of *E. cucullata* and *E. vitiensis* are very distinct, although occurring in the same area. In their atypical varieties, however, the two species approach each other in foliage characters.

The two recognized varieties of *E. cucullata* may be distinguished as follows:

- Petioles 1.5-5 cm. long; leaflet-blades usually 4-8 × 2-3.7 cm., with 6-9 pairs of secondary nerves; shrub or tree 2-5 m. high, occurring at elevations of 700-1220 m.....5a. var. *cucullata*.
- Petioles (2.5-)3-7.5 cm. long; leaflet-blades usually 6-13.5 × 2.5-7 cm., with 7-12 pairs of secondary nerves; usually a tree 5-13 m. high, rarely a smaller shrub, occurring at elevations of sea-level to 500 m.....5b. var. *robustior*.

5a. *Evodia cucullata* var. *cucullata*.

Evodia cucullata Gillespie in Bishop Mus. Bull. 91: 10. fig. 11. 1932.
DISTRIBUTION: Fiji, thus far known from Viti Levu, Vanua Levu, and Taveuni, at elevations of 700-1220 m., occurring in various types of forest, in hillside thickets, or in dense crest vegetation. It has been noted as a shrub or slender tree 2-5 m. high, with white petals and filaments; the petals sometimes have noticeable greenish glands. A local name is *ndrautolu*.

FIIJI: VITI LEVU: Mba : Vicinity of Nandarivatu, Gillespie 3743 (Bish, GH), Degener & Ordonez 13609 in part (NY); slopes of Mt. Nanggaranambuluta [Lomalangi], Gillespie 3198 (Bish TYPE, GH, K, NY, UC), B. E. Parham 2146 (A); slopes of the escarpment north of Nandarivatu, Smith 6086 (A, US). VANUA LEVU: Mbu a : Summit of Mt. Seatura, Smith 1675 (Bish, GH, K, NY, UC, US); Thakaundrove : Summit of Mt. Mbatini, Smith 686 (Bish, GH, K, NY, UC, US). TAVEUNI: Borders of lake east of Somosomo, Smith 872 (Bish, GH, K, NY, UC, US); summit of Uluingalau, Smith 894 (Bish, GH, K, NY, UC, US).

The available specimens seem to be strictly dioecious. The following bear staminate flowers: Gillespie 3198, 3743, Parham 2146, Smith 686, 872, 6086. My no. 1675 is in fruit, while no. 894 and Degener & Ordonez 13609 have pistillate flowers. The pistillate flowers have stamens superficially like those of staminate flowers, but no pollen was detected; the disk in pistillate flowers is inconspicuous, pulvinate, and minutely hispidulous; the ovary is deeply 4-lobed and minutely puberulent-sericeous,

each lobe being 2-ovulate; the style is stout, 1.3–1.5 mm. long, enlarging distally into a capitate stigma about 1 mm. in diameter.

5b. *Evodia cucullata* var. *robustior* var. nov.

Arbor (raro frutex) 5–13 m. alta, a var. *cucullata* petiolis longioribus, foliolorum laminis majoribus nervis secundariis numerosioribus differt; petiolis (2.5–)3–7.5 cm. longis, petiolulis lateralibus 2–10 mm. terminalibus ad 15 mm. longis, foliolorum laminis ellipticis vel elliptico-obovatis, (5–)6–13.5 cm. longis, (2–)2.5–7 cm. latis, apice rotundatis et manifeste emarginatis, nervis secundariis utrinsecus 7–12 patentibus; inflorescentiis 3–7 cm. longis et paullo angustioribus, pedicellis sub fructu juvenili 2–3 mm. longis.

DISTRIBUTION: Fiji, known from several of the islands, at elevations from sea-level to 500 m. A variety of habitats is recorded, including forest on limestone, open forest, thickets, and among reeds. The plant is usually a tree 5–13 m. high, but one specimen (*Smith 1505*) was noted as a gnarled shrub 0.5 m. high on limestone cliffs, in a very exposed location. Local names are *ndrautolu* and *tokatolu* (more or less generic in Fiji), and *nggaringarikalavu* (Mathuata). Degener (no. 15047) noted that a medicinal tea is prepared from the fresh or dried leaves. Most of the specimens are in fruit, but young staminate inflorescences accompany my nos. 6372 and 6568. The young petals are pale yellow, and the staminate flowers do not materially differ from those of var. *cucullata*. Since the most mature flowers occur on no. 6372, that collection is indicated below as the type of the new variety.

FIJI: VITI LEVU: Nandronga & Navosa: Mbulu, near Sovi Bay, *Degener 15047* (A, Bish, K, NY); Naitasiri or Rewa: Central Road, near Suva, *Tothill F514* (Bish, K). MBENGGA: Ndakuni, *B. E. Parham & P. Turaga 2083* (A). VANUA LEVU: Mathuata: Southern slopes of Mt. Numbuiloa, east of Lambasa, Oct. 27, 1947, *Smith 6372* (A TYPE, US); same locality, *Smith 6568* (A, US); Thakaundrove: Yanawai River region, Mt. Kasi, *Smith 1778* (Bish, GH, K, NY, UC, US). KORO: East coast, *Smith 1041* (Bish, GH, K, NY, UC, US). VANUA MBALAVU: Northern limestone section, *Smith 1505* (Bish, GH, K, NY, UC, US); southern limestone section, Malatta islet, *Smith 1436* (Bish, GH, K, NY, UC, US). KAMBARA: On limestone formation, *Smith 1251* (Bish, GH, K, NY, UC, US). Fiji, without definite locality: *Seemann 102* in part (K), *103* in part (GH).

6. *Evodia vitiensis* sp. nov.

Arbor (vel raro frutex) 2–14 m. alta, ramulis robustis subteretibus, internodiis distalibus plus minusve quadrangularibus vel complanatis, partibus juvenilibus copiose cinereo-puberulis mox subglabratibus; foliis oppositis trifoliolatis, petiolo (1.5–)2–13 cm. longo subtereti vel supra complanato ut ramulis petiolulisque inconspicue puberulo, petiolulis lateralibus 1–15 mm. terminalibus ad 17 mm. longis; foliolorum laminis papyraceis in sicco plerumque fusco-viridibus copiose sed saepe obscure glanduloso-punctatis, ellipticis vel oblongo-ellipticis, (5–)6–20 cm. longis, (2.5–)3–11 cm. latis, basi obtusis vel subacutis, apice acuminatis vel

cuspidatis (apice ipso saepe 5–15 mm. longo calloso-apiculato interdum rotundato vel leviter emarginato), margine saepe anguste recurvatis et undulatis, utrinque glabris vel subtus costa et nervis inconspicue puberulis, costa supra subplana vel leviter impressa subtus prominente, nervis secundariis utrinsecus 7–13 patentibus supra subplanis subtus elevatis, rete venularum intricato subtus prominulo; inflorescentiis axillaribus paniculatis multifloris pedunculo ad 4 cm. longo incluso ad 11 cm. longis latisque, ramulis pedicellisque copiose puberulis vel puberulo-tomentellis (pilis cinereo-fulvis circiter 0.1 mm. longis); pedicellis gracilibus teretibus sub anthesi 0.7–2 mm. longis; calyce cupuliformi sub anthesi 1.5–2 mm. diametro parce luteo-glanduloso ut pedicellis puberulo vel glabrato profunde 4-lobato, lobis ovato-delloideis $0.6-1 \times 0.7-1.4$ mm. apice subacutis vel rotundatis; petalis 4 submembranaceis vel tenuiter carnis parce glanduloso-punctatis glabris oblongis vel oblongo-ellipticis, 1.8–2.5 mm. longis, 1–1.6 mm. latis, apice obtusis vel subacutis et minute cucullatis; staminibus 4, filamentis ligulatis glabris 1.3–3.5 mm. longis, antheris oblongis 0.6–1 mm. longis apice rotundatis, in floribus ♀ sterilibus; disco in floribus ♂ pulvinato obscure lobato 0.3–0.5 mm. alto 1–1.3 mm. diametro pilis fulvis 0.2–0.4 mm. longis copiose hispidulo-tomentello, ovario sterili minuto in disco immerso vel subnullo, stylorum vestigiis 4 laxe connatis minutis vel nullis; disco in floribus ♀ subsimili stipitiformi, ovario profunde 4-lobato ut disco piloso vel puberulo vel glabro, lobis biovulatis, ovulis oblique superpositis, stylo crasso tereti 0.8–1.5 mm. longo inferne strigilloso vel glabro, stigmatibus peltato-capitato 4-lobato 0.8–1 mm. diametro; pedicellis sub fructu ad 4 mm. longis, calyce persistente, disco manifeste hirtello; fructus carpellis subliberis (1, 2, vel 3 interdum abortis) puberulis vel glabratis copiose luteo-glandulosis obovato-ellipsoideis, plerumque 4–4.5 mm. longis et 2.5–3 mm. latis, apice rotundatis, seminibus 2 (vel 1) nigris levibus nitidis ellipsoideo-subglobosis 2.5–3 mm. longis latisque.

DISTRIBUTION: Fiji, known from several of the islands and probably to be expected throughout the group. It appears to be the most abundant Fijian species of the genus. As type of the species I designate my no. 6176, of which numerous duplicates are available, a collection from Viti Levu with young staminate inflorescences.

The concept outlined by the above description is hardly to be distinguished in inflorescence from *E. cucullata*, but, as discussed above under that species, it seems too different in foliage to be considered conspecific. *Evodia vitiensis* may be divided into two varieties, distinguishable as follows:

- Petioles (2.5–)4–13 cm. long; leaflet-blades usually $8-20 \times 4-11$ cm., the apex 5–15 mm. long, usually callose-tipped, rarely faintly emarginate; inflorescence 4.5–11 cm. long.....6a. var. *vitiensis*.
 Petioles (1.5–)2–6.5 cm. long; leaflet-blades usually $6-12 \times 3-6$ cm., the apex cuspidate or short-acuminate, usually faintly emarginate; inflorescence 2–6(–9) cm. long.....6b. var. *minor*.

6a. *Evodia vitiensis* var. *vitiensis*.

Evodia roxburghiana sensu Seem. Fl. Vit. 31. 1865, p. p.; non Benth.

DISTRIBUTION: Fiji, known from several islands at elevations of 100–1150 m., occurring as a tree 2–13 m. high in various types of forest or in hillside thickets; the petals are white to pale yellow. Recorded local names are *ndrautolu* (general), *kai tambua* (upland Viti Levu), and *vure* (Moala).

FIJI: VITI LEVU: Mba: Vicinity of Nandarivatu, *Parks 20791* (Bish, UC), *Degener & Ordonez 13609* in part (A); Mt. Nanggaranambuluta [Lomalangi], *Gillespie 4062* (Bish, UC); hills between Nandala and Nukunuku Creeks, along trail from Nandarivatu toward Lewa, Sept. 22, 1947, *Smith 6176* (A TYPE, US); slopes of the escarpment north of Nandarivatu, *Smith 6069* (A, US); valley of Nandala Creek, south of Nandarivatu, *Degener 14282* (A, Bish, K, NY, UC, US), *14393* (A, NY), *14547* (A, Bish, K, NY, UC, US); valley of Nggaliwana Creek, *Smith 5336* (A, US); hills between Nggaliwana and Tumbeindreketi Creeks, *Smith 5867* (A, US); Navai valley, near Vunindawa trail, *Gillespie 4133* (Bish, GH, K, NY, UC); southern slopes of Mt. Tomanivi [Mt. Victoria], *Smith 5215* (A, US); Naitasiri: Vicinity of Nasinu, *Gillespie 3439* (Bish, GH, UC, US). KANDAVU: Hills above Namalata and Ngaloa Bays, *Smith 104* (Bish, GH, K, NY, UC, US). TAVEUNI: Vicinity of Wairiki, *Gillespie 4803* (Bish, GH, UC). MOALA: Near Naro, *Smith 1312* (Bish, GH, K, NY, UC, US). Fiji, without definite locality: *Seemann 102* in part (K).

6b. *Evodia vitiensis* var. *minor* var. nov.

Evodia drupacea sensu A. Gray, Bot. U. S. Expl. Exped. 1: 332. 1854; Seem. Fl. Vit. 30. 1865, p. p.; non Labill.

Evodia roxburghiana sensu Seem. Fl. Vit. 31. 1865, p. p.; non Benth.

Arbor (raro frutex) ad 14 m. alta, a var. *vitiensi* petiolis brevioribus, foliolorum laminis minoribus apice brevius acuminatis vel cuspidatis plerumque leviter emarginatis, inflorescentia brevior differt; petiolis (1.5–)2–6.5 cm. longis, foliolorum laminis (5–)6–12(–14) cm. longis, (2.5–)3–6 cm. latis; inflorescentiis 2–6 cm. longis latisque vel raro ad 9 cm. longis.

DISTRIBUTION: Fiji, thus far known from Viti Levu, Vanua Levu, and Taveuni, at elevations from near sea-level to 1100 m. It has been noted as a tree 4–14 m. high (rarely as a shrub 2 m. high) in forest, woods, and thickets, with white or pale yellow petals. Local names are *ndrautolu* (general), *nggaringgarikalavu* (on Taveuni), and *kai tambua* (upland Viti Levu). As type I indicate my no. 325, from Thakaundrove, Vanua Levu, a collection with well developed staminate inflorescences, of which duplicates are widely distributed.

FIJI: VITI LEVU: Mba: Mt. Evans Range, east of Lautoka, *Greenwood 387* (K), *1088* (A, Bish); between Mba and Tavua, *Greenwood 797* (K); Naitasiri: Northern portion of Rairaimatuku Plateau, between Mt. Tomanivi and Nasonggo, *Smith 6089* (A, US); Nandronga & Navosa: Southern slopes of Nausori Highlands, in drainage of Namosi Creek above Tumbenasolo, *Smith 4711* (A, US). VANUA LEVU: Mbua: Southern portion of Seatovo Range, *Smith 1527* (Bish, GH, K, NY, UC, US); Mathuata: Hills near Lambasa, *Greenwood 574* (K), *574A* (K); Mathuata coast, *Greenwood 574B* (K); Seanggangga Plateau,

vicinity of Natua, *Smith* 6745 (A, US); Undu Point, *Tothill* 53 (K); Thaka undrove: Hills south of Nakula Valley, *Smith* 325 (Bish, GH, K, NY, UC, US 1676076 TYPE); Maravu, near Salt Lake, *Degener & Ordoñez* 14194 (A, Bish, K, NY, UC, US). TAVEUNI: *Seemann* 103 (GH in part, K); vicinity of Waiyevo, *Gillespie* 4638 (Bish, GH, K, NY, UC, US); western slope, between Somosomo and Wairiki, *Smith* 762 (Bish, GH, K, NY, UC, US); vicinity of Wairiki, *Gillespie* 4673 (Bish, UC). Fiji, without definite locality: *U. S. Expl. Exped.* (GH, US 15051), *Horn* 289 (GH).

7. *Evodia evansensis* sp. nov.

Arbor 4–10 m. alta, ramulis fuscis subteretibus, internodiis distalibus subcomplanatis, partibus juvenilibus copiose cinereo-puberulis, demum glabratis; foliis oppositis trifoliolatis, petiolo 3.5–7 cm. longo subtereti vel inconspicue canaliculato ut ramulis petiolulisque puberulo et demum glabrato, petiolulis lateralibus 2–5 mm. terminalibus 8–15 mm. longis; foliolorum laminis papyraceis inconspicue immerso-glandulosis in sicco fusco-viridibus, lanceolatis vel ovato- vel obovato-lanceolatis, 6–12 cm. longis, 2.5–5.5 cm. latis (lateralibus quam terminali paullo minoribus interdum 5×2 cm.), basi acutis, apice gradatim acuminatis vel obtuse cuspidatis et calloso-apiculatis, margine saepe inconspicue recurvatis, supra glabris vel evanescenter puberulis, subtus secus costam et nervos pilis circiter 1 mm. longis hispidulo-tomentellis vel tantummodo puberulis (pilis longioribus paucis plerumque persistentibus), costa supra plana vel leviter impressa subtus prominente, nervis secundariis utrinsecus 7–10 recto-patentibus supra subplanis subtus elevatis, rete venularum subimmerso; inflorescentiis sub fructu solis visis axillaribus late paniculatis pedunculo brevi incluso 5–13 cm. longis latisque, ramulis gracilibus minute puberulis, pedicello sub fructu gracili tereti 2.5–4 mm. longo pilis pallidis ad 0.1 mm. longis dense puberulo; calyce persistente rotato 2.5–3 mm. diametro ut pedicello copiose puberulo profunde 4-lobato, lobis deltoideis circiter 1×1.3 mm. subacutis; petalis caducis; staminibus subpersistentibus 4, filamentis ligulatis glabris 0.5–1 mm. longis, antheris ellipsoideis 0.4–0.5 mm. longis apice rotundatis ut videtur sterilibus; disco sub fructu inconspicuo pilis 0.1–0.15 mm. longis copiose hispidulo; fructus carpellis subliberis (1, 2, vel 3 interdum abortis) copiose et persistenter hispidulo-puberulis (pilis pallidis 0.1–0.2 mm. longis), ellipsoideis, 6–9 mm. longis, 5–7 mm. latis, apice rotundatis, seminibus 1 vel 2 (ovulis in carpellis juvenilibus semper 2) nigris levibus nitidis ellipsoideis, 5–7 mm. longis, 4–5.5 mm. latis.

DISTRIBUTION: Fiji, known only from the isolated Mt. Evans Range in northwestern Viti Levu, at an altitude of 950–1195 m.

FIJI: VITI LEVU: Mba: Eastern slopes of Mt. Koroyanitu, Mt. Evans Range, May 2, 1947. *Smith* 4241 (A TYPE, US) (tree 10 m. high, in dense low forest); summit of Mt. Koroyanitu, high point of range. *Smith* 4205 (A, US) (*ndrautolu*; tree 8 m. high, in dense ridge forest and thickets); near summit of Mt. Evans Range [Mt. Mbotilamu], *Greenwood* 323 (K) (tree 4 m. high, the very young flower-buds white).

Although the species here described is obviously a close relative of *E. cucullata* and *E. vitiensis*, the dense and persistent indument of the fruiting carpels and the characteristic hairs on the lower surfaces of leaflets sharply distinguish it. It is noted that fruits and seeds of the new species are considerably larger than those of its two relatives, but this character is perhaps not very significant.

3. ACRONYCHIA J. R. & G. Forst.

The species of *Acronychia* in our region, although few, are extremely difficult to characterize. Whereas in *Evodia* the complex species are Fijian, in *Acronychia* they are Samoan. The single Fijian species, *A. petiolaris*, is the most distinct in the region, and the single species known from Tonga and Niue, *A. niueana*, is also fairly well characterized. However, the Samoan population demonstrates no inflorescence differentiation of consequence, and for specific delimitation it seems necessary to rely entirely upon foliage characters, flexible and unsatisfactory as these are.

Seven species are recognized in our region, all of them having been adequately described.

KEY TO THE SPECIES

- Disk (in both ♂ and ♀ flowers) glabrous; filaments (in both ♂ and ♀ flowers) broadly ligulate, conspicuously ciliolate for most of length; flowers subsessile (pedicels minute even in fruit), with copiously sericeous-puberulent calyx and petals; fruit indehiscent, very thick-walled, persistently pilose; leaves 1-foliolate, the petiole usually 2–4.5 cm. long; Fiji.....1. *A. petiolaris*.
- Disk (in both ♂ and ♀ flowers) hispidulous or strigillose with hairs 0.1–0.3 mm. long (merely puberulent in no. 4); filaments glabrous or pilose proximally, not uniformly ciliolate; flowers pedicellate (pedicels at anthesis rarely 1 mm. long, usually longer); mature fruit obscurely puberulent or glabrate, comparatively thin-walled, dehiscent; Samoa, Tonga, and Niue.
 - Leaves 1-foliolate, comparatively small, the petiole 0.4–2(–2.3) cm. long, the leaflet-blade usually obovate or oblanceolate, 3–10 × 1.5–4.2 cm., obtuse and minutely apiculate at apex; inflorescence compact, few-flowered, scarcely exceeding 1 cm. in length at anthesis; Samoa....2. *A. richii*.
 - Leaves 1- or 3-foliolate, the petiole more than 1.5 cm. long (rarely 1 cm., usually more than 2 cm.), the leaflet-blades 5–19 × 3–10 cm., rarely smaller; inflorescence at anthesis rarely less than 2 cm. long.
 - Leaflet-blades (leaves always 1-foliolate) elliptic to obovate, rounded at apex and often obviously retuse.
 - Disk hispidulous or strigillose with hairs 0.1–0.2 mm. long; filaments hispidulous, especially on margins, near base; pedicels in fruit 1.5–2 mm. long, the capsule 3–4 mm. high, the seeds 2.5–3 mm. long; leaflet-blades 5–15 × 3–7.5 cm., with 6–9 secondary nerves; Samoa.....3. *A. retusa*.

Disk hispidulous-puberulent with hairs less than 0.1 mm. long; filaments glabrous or obscurely ciliate toward base; pedicels in fruit 2-5 mm. long, the capsule 5-6 mm. long, the seeds about 4 mm. long; leaflet-blades 9-19 × 3.5-10 cm., with 7-15 secondary nerves; Tonga and Niue.....4. *A. niueana*.

Leaflet-blades usually acuminate or gradually narrowed toward apex (actual apex sometimes rounded or obtuse, occasionally faintly emarginate); Samoan species.

Leaves 1-foliolate, the single leaflet essentially sessile at the apical articulation of petiole (i.e. petiolule 0-3 mm. long); leaflet-blades obtuse to acute at base, with 10-15 secondary nerves; known only from Savaii.....5. *A. boweriana*.

Leaves usually 3-foliolate but sometimes 1-foliolate and then with the single leaflet obviously petiolulate above the apical articulation of petiole; petiolules of terminal leaflet 3-28 mm. long, of lateral leaflets 2-22 mm. long; leaflet-blades attenuate at base and decurrent on the petiolule, with 6-13 secondary nerves.

Leaflet-blades lanceolate, oblanceolate, or narrowly elliptic, about 3 times as long as broad, usually 7-15 × 2.5-5.5 cm. (rarely to 22 × 8 cm.), the secondary nerves 6-10 per side, spreading from the costa at an angle of 60-80°; known only from Savaii and Upolu.....6. *A. albiflora*.

Leaflet-blades elliptic, obovate-elliptic, or lanceolate-elliptic, about twice as long as broad, usually 7-19 × 4-9 cm., the secondary nerves 6-13 per side, erecto-patent, forming an angle of 55-65° with the costa; known only from Tutuila...7. *A. heterophylla*.

8. **Acronychia petiolaris** A. Gray, Bot. U. S. Expl. Exped. 1: 335. pl. 33, A. 1854; C. Muell. in Walp. Ann. Bot. Syst. 4: 416. 1857; Seem. Fl. Vit. 31. 1865; Gibbs in Jour. Linn. Soc. Bot. 39: 142. 1909.

DISTRIBUTION: Endemic to Fiji and thus far known only from Viti Levu and Vanua Levu, at elevations of 60-970 m. It is usually a slender tree 5-12 m. high, sometimes a shrub 2-5 m. high, occurring in various types of forest or thickets; in Mathuata it is a typical component of patches of dry forest in prevalingly open country. The petals and filaments are white, greenish white, or pale yellow, and the anthers are yellow. Recorded local names are *mariko* and *kai singa* (Nandarivatu region), *ndongotuva* (Mbua), and *nggaringgarikalavu* (Mathuata). Mead has noted that the wood is used for house-building in the vicinity of Nandarivatu.

FIJI: VITI LEVU: Mba: Vicinity of Nandarivatu, *Parks 20710* (Bish, UC), *Gillespie 3984* (Bish, GH, NY, UC), *4311* (Bish, GH, K, UC, US), *Tothill 54* (K), *Mead 1987* (K); southern slopes of Mt. Ndelainathovu, on the escarpment west of Nandarivatu, *Smith 4934* (A, US); hills between Nandala and Nukunuku Creeks, along trail from Nandarivatu toward Lewa, *Smith 6150* (A, US); Sovutawambu, south of Nandarivatu, *Degener 14652* (A, Bish, K, NY, UC, US). VANUA LEVU: Mbua: *Horne 1114* (GH, K); southern portion of Seatovo Range, *Smith 1702* (Bish, GH, K, NY, UC, US); Mathuata: Mathuata coast, *U. S. Expl. Exped.* (GH, US 15292 TYPE); vicinity of Lambasa, *Greenwood 566* (K); southern slopes of Mt. Numbuiloa, east of Lambasa, *Smith 6407* (A, US); southern base of Mathuata Range, north of Natua, *Smith 6779* (A, US); Seang-

gangga Plateau, in drainage of Korovuli River, vicinity of Natua, *Smith 6711* (A, US), *6728* (A, US); Wainunu-Ndreketi divide, *Smith 1841* (Bish, GH, K, NY, UC, US). Fiji, without definite locality: *Horne 599* (GH, K).

Of the species of *Acronychia* in our region, *A. petiolaris*, the only Fijian species, is the most distinct in fundamental characters. It differs from the species of Samoa, Tonga, and Niue in having a thick-walled, indehiscent, persistently pilose fruit. As indicated by my key, it also differs from its congeners in its glabrous disk, conspicuously ciliolate filaments (which are as fully developed in ♀ as in ♂ flowers), unusually densely pilose petals, and subsessile flowers. Other Fijian material which had been referred to *Acronychia* in herbaria proves, upon more careful examination, to belong in either *Melicope* or *Evodia*.

Gillespie has identified his and Parks' specimens, cited above, as *A. baueri* Schott (1834), and that Australian species is indeed very suggestive of *A. petiolaris* in facies and even in such floral details as the conspicuously ciliolate filaments. However, *A. baueri* has the calyx-lobes definitely oblong rather than deltoid, the disk (in both ♂ and ♀ flowers) pulvinate-cupuliform and with its upcurved margins extending laterally beyond the base of the ovary (rather than merely stipitiform), and the fruit somewhat angled, with a thinner pericarp, and probably tardily dehiscent (rather than round in cross-section, very thick-walled, and apparently not dehiscent even at full maturity). However, the Fijian plant is certainly more closely allied to *A. baueri* than it is to any of the Samoan species of the genus.

2. *Acronychia richii* A. Gray, Bot. U. S. Expl. Exped. 1: 336. *pl. 33, B.* 1854; C. Muell. in Walp. Ann. Bot. Syst. 4: 416. 1857; Lauterb. in Bot. Jahrb. 41: 228. 1908; Christophersen in Bishop Mus. Bull. 128: 109. 1935.

DISTRIBUTION: Samoa, known with certainty only from Savaii and Tutuila, at elevations of 500–600 m. (Tutuila) to 1500–1700 m. (Savaii). Except for the type, the only available material is that collected and cited by Christophersen, who records the plant as a shrub or tree 2–4 m. high, with white flowers and green fruit, growing in wet scrub-forest or in high elevation rain-forest.

SAMOA: SAVAII: Tuisivi Range, above Safotu-Letui, *Christophersen 784* (Bish, NY), *812* (Bish, K, NY, UC, US); above Matavanu Crater, *Christophersen & Hume 2257* (Bish, NY). TUTUILA: Matafao Ridge, *Christophersen 1052* (Bish), *1066* (Bish); top of Le Pioa, *Christophersen 3532* (Bish, NY, UC), *3556* (Bish, K). Samoa, without definite locality: *U. S. Expl. Exped.* (GH, NY, US 15295 TYPE).

Among the Samoan *Acronychiae*, *A. richii* seems to be the most distinct entity, although its differentiating characters are perhaps merely those pertaining to a reduction in size of certain parts. In flowers, the species is essentially similar to the others in Samoa, with the exception that its petals, filaments, and anther-connectives are possibly more copiously glandular-punctate than usual. The very reduced and few-flowered inflorescence

escences and the short-petiolate, comparatively small, unifoliolate leaves permit recognition of the species. Christophersen points out minor foliage differences between the material from Savaii and Tutuila.

3. *Acronychia retusa* A. Gray, Bot. U. S. Expl. Exped. 1: 338. *pl.* 34, *A.* 1854; C. Muell. in Walp. Ann. Bot. Syst. 4: 416. 1857; Lauterb. in Bot. Jahrb. 41: 228. 1908; Christophersen in Bishop Mus. Bull. 128: 108. 1935.

Melicope vaupelii Lauterb. in Bot. Jahrb. 41: 227. 1908; Rechinger in Denkschr. Akad. Wiss. Wien 85: 294. 1910.

DISTRIBUTION: Samoa, known with certainty only from Savaii and Upolu, where it occurs in coastal thickets or forests. It has been recorded as a shrub, up to 3 m. high, with green fruits.

SAMOA: SAVAII: Coastal regions, *Vaupel* 67 (type coll. of *Melicope vaupelii*, Bish, K, US); back of Safotu (Safune), in coconut plantation, *Christophersen & Hume* 2437 (Bish, US); Sataua-Papa, *Christophersen & Hume* 3414 (Bish, K, NY, UC). UPOLU: Near Leulumoenga, *Rechinger* 73 (US). Samoa, without definite locality: *U. S. Expl. Exped.* (GH, NY, US 15294 TYPE), *Powell* (K), *Whitmee* (K). Rechinger cites material from Savaii and Upolu which I have not seen.

Acronychia retusa may be readily distinguished from *A. richii* by its comparatively large (also unifoliolate) leaves, of which the apices are rounded and usually obviously retuse. The texture of its leaflet-blades is somewhat thinner than that of *A. richii*, its inflorescences are more simple, and the glands of both foliage and flowers are less obvious. It is to be noted that *A. retusa* is a coastal plant, while *A. richii* is known only from inland forests near the highest elevations of the islands where it occurs. Direct comparison of the type collections of the two binomials concerned leaves no doubt of the correctness of the reduction of *Melicope vaupelii*, as proposed by Christophersen.

4. *Acronychia niueana* St. John in Bishop Mus. Bull. 178: 67. *fig.* 3. 1943.

DISTRIBUTION: Tonga (Tongatabu Island) and Niue, at low elevations, occurring as a tree or shrub 2-5 m. high in thickets or on the edges of forest. The petals are said to be white or greenish white, and the fruit is green. On Niue Yuncker records the local names *kalakalalai*, *kalapalai*, and *kalakalai*, noting that the leaves are used in native medicine to treat skin irritations. A local name of *palagi* was noted on Tongatabu. Three collections, *Yuncker* 9917, 9637, and 9753, were originally cited by St. John as syntype (first two) and androtype (third); Prof. Yuncker has kindly loaned me his specimens of this species.

TONGA: TONGATABU: *Setchell & Parks* 15184 (UC); near Fanogatina, *Setchell & Parks* 15466 (Bish, K, UC).

NIUE: Southwest of Lakepa village, *Yuncker* 9917 (DP COTYPE COLL.); south of Liku village, *Yuncker* 9753 (DP COTYPE COLL.); east of Alofi, *Yuncker* 9637 (DP COTYPE), 9777 (DP, US), 10083 (DP, US).

As pointed out by St. John, the alliance of the only *Acronychia* known from Niue (to which the Tongatabu specimens here cited may safely be

referred) is with *A. retusa*. In the original publication a number of characters differentiating the two species are elaborated, but it appears to me that the only ones of significance refer to the indument of the disk (although this is too minute a feature to be very useful) and filaments, the length of fruiting pedicels, and the size of the mature capsules and seeds. In general, *A. niueana* has leaflet-blades larger and with more numerous secondaries, on the average, than those of *A. retusa*.

5. *Acronychia boweriana* Christophersen in Bishop Mus. Bull. 128: 106. fig. 13. 1935.

DISTRIBUTION: Samoa; the only specimens thus far known are from Savaii at elevations of 1000–1500 m., where Christophersen found the plant locally common. It is a tree, or occasionally a shrub, 2–8 m. high, growing in wet forest or in open scrub-forest; the flowers are white.

SAMOA: SAVAII: Above Matavanu Crater, *Christophersen & Hume 2016* (Bish, K, NY, UC, US), *2152* (Bish TYPE, K, NY, UC, US); above Salailua, *Christophersen 2666* (Bish, K, US), *2668* (Bish, NY, UC, US), *3082* (Bish, K, NY, UC, US), *3085* (Bish, K, NY, UC, US); Aoponngangamala, *Christophersen 3451* (Bish, NY).

Christophersen refers his species to the alliance of *A. albiflora* Rechinger, stating that it differs "in its larger and narrower leaves, style shorter than ovary, ovary puberulous." These characters do not seem very adequate in this species-complex, where length of style and abundance of ovary-indument are flexible. However, I am inclined to agree with Christophersen in maintaining *A. boweriana* as distinct from Rechinger's species. The type of *A. albiflora*, which neither Christophersen nor I has examined, was collected near Lanutoo, Upolu, whereas *A. boweriana* appears to be strictly limited to high elevations on Savaii.

The only concrete character that I have found dependable in considering the unifoliate Samoan *Acronychiae* with large and distally narrowed (rather than rounded) leaflet-blades lies in the articulation of the petiole with the single leaflet. In *A. boweriana* the leaflet is essentially sessile upon the articulation, while the contrasting form has the leaflet obviously petiolulate. Specimens of the latter group are found on all three of the large Samoan islands; the usual condition of the leaves here would appear to be trifoliate. Disappearance of the lateral leaflets results in a unifoliate condition in which the remaining leaflet is still conspicuously petiolulate. In describing *A. albiflora* Rechinger did not mention this character, but the fact that his type came from Upolu lends weight to a supposition that his species is not the same as *A. boweriana*.

6. *Acronychia albiflora* Rechinger in Denkschr. Akad. Wiss. Wien 85: 294. 1910.

Melicope tahitensis var. *glabra* Lauterb. in Bot. Jahrb. 41: 227. 1908.

Acronychia sp. Christophersen in Bishop Mus. Bull. 128: 109, 110. 1935.

DISTRIBUTION: Samoa, known only from Savaii and Upolu, at elevations of 550–1500 m. The species is reported as a small tree or shrub 3–7 m. high, occurring in wet or low forest or on forest-edges; the flowers are

white and the fruit green. Local names recorded by Christophersen are *matatalafi* (on Savaii) and *alo alo* or *fua nini'i* (on Upolu). The type is Rechinger 147, collected near Lanutoo, Upolu.

SAMOA: SAVAII: Maugaloa, *Vaupel* 343 (type coll. of *Melicope tahitensis* var. *glabra*, K, US); above Matavanu Crater, *Christophersen* 837 (Bish, K, NY), *Christophersen & Hume* 1988 (Bish, K), 2091 (Bish), 2162 (Bish, UC, US), 2172 (Bish, NY), ?2175 (small-leaved form, Bish, NY, UC); above Salailua, *Christophersen* 2673 (Bish, K, NY, US); rim of Papafu Crater, *Christophersen* 2724 (Bish). UPOLU: Near Malololelei, *Christophersen* 329 (Bish, K); Lanutoo, *Christophersen* 392 (Bish, NY, UC). Samoa, without definite locality: *Whitmee* 29 (or 79?) (K).

The material here referred to *A. albiflora* is diverse in size of leaflets, but fairly consistent as to leaf-texture, shape, and venation. Floral characters scarcely serve to distinguish species in the complex involving this entity, *A. boweriana*, and *A. heterophylla*. The only available collection from the type locality of *A. albiflora* (Lanutoo, Upolu) is *Christophersen* 392, which has trifoliate leaves, with leaflets somewhat larger than those described by Rechinger. However, it is seen here and elsewhere (e. g. in *A. heterophylla*) that unifoliate and trifoliate leaves occur on the same plant; in other plants one or the other type of leaf is predominant, sometimes exclusively so. The type of *A. albiflora* is described as having entire (i. e. unifoliate?) leaves; the original description seems to apply very well to the type collection of *Melicope tahitensis* var. *glabra*, from Maugaloa, Savaii (*Vaupel* 343, cited above). *Vaupel* 343 has predominantly unifoliate leaves, but occasional trifoliate leaves are also present on the specimens.

The closest relationship of *A. albiflora*, if my identification is correct, is with *A. heterophylla*. Although the extreme forms of these two species seem quite different, an analysis of the available material indicates that only generalizations concerning the leaflet-shape and direction of the nerves differentiate them.

Acronychia heterophylla A. Gray, Bot. U. S. Expl. Exped. 1: 333. pl. 32. 1854; C. Muell. in Walp. Ann. Bot. Syst. 4: 416. 1857; Lauterb. in Bot. Jahrb. 41: 228. 1908; Setchell in Carnegie Inst. Publ. 341: 88. 1924; Christophersen in Bishop Mus. Bull. 128: 108. 1935.

Acronychia diversifolia A. Gray, Bot. U. S. Expl. Exped. 1: 334. 1854, sphalm.

Evodia vatiana Setchell in Carnegie Inst. Publ. 341: 87. pl. 4, fig. E. 1924.

DISTRIBUTION: Samoa, known with certainty only from Tutuila, where it occurs in forest at 100-400 m. as a tree or shrub 3-10 m. high. Recorded local names are *matamo* (by Setchell), *usi vao* (by Garber), and *fua feti'i* (by Christophersen).

SAMOA: TUTUILA: U. S. Expl. Exped. (GH, NY, US 15289 and 15290 TYPE); above Vatia, Setchell 329 (UC type of *Evodia vatiana*); vicinity of Pago Pago, Sütupe (in Setchell) 429 (UC), Wilder 34 (Bish),

Garber 909 (Bish, K, NY); Alava ridge, *Christophersen 1137* (Bish, NY, UC); along Aua-Afono trail, *Yuncker 9426* (Bish, DP). Samoa, without definite locality: *Powell 234* (K), *286* (K).

Specimens referable to this entity have predominantly trifoliolate leaves, although unifoliolate leaves are of common occurrence, even in type material, as noted by Gray. So far as is known with certainty, this species is limited to Tutuila, while the closely related *A. albiflora* has been collected only on Savaii and Upolu. The foliage characters which separate these two entities, as indicated in my key, are not pronounced, but they seem adequate. In addition, the leaflet-blades of *A. heterophylla* seem somewhat thinner in texture and duller, with more obvious secondaries, as contrasted with those of *A. albiflora*.

The type specimen of *Evodia vatiana*, cited above, has been carefully examined; it is a staminate specimen with extremely small and immature flowers. Although the original description states, "staminibus 4," dissections of several flowers have established that the stamens are always 8, alternately unequal; the undeveloped sterile ovary is seen to be 4-sulcate but apparently not deeply lobed. These characters indicate that the species represents *Acronychia*, and close comparison with the type of *A. heterophylla* fails to disclose differences of consequence. In inflorescence-indument, leaflet-texture, etc., the two types are indistinguishable. The type of *Evodia vatiana* has the leaflets obtuse to rounded and lightly emarginate at apex, whereas in the Exploring Expedition material they are often short-acuminate (but sometimes merely obtuse), the actual apex also being emarginate to a greater or lesser degree. Among the material cited there is considerable variation in leaflet-apex, and the type of *Evodia vatiana* can be precisely matched in this character by some of the leaflets of *Garber 909* and *Wilder 34*.

4. MELICOPE J. R. & G. Forst.

In Samoa, two entities have thus far been accredited to *Melicope*, but neither of them actually belongs to that genus, *M. vaupelii* Lauterb. being a synonym of *Acronychia retusa*, and *M. tahitensis* var. *glabra* Lauterb. being referable to *Acronychia albiflora*. However, it appears that there is a Samoan plant which should be placed in *Melicope*; this is *Pelea lucida* A. Gray, for which I here propose a new combination.

Melicope has not yet been mentioned in the literature as occurring in Fiji, but in current collections I find four entities in the genus which appear to merit specific recognition. Individuals of *Melicope* are very scarce in Fiji, extraordinarily so in Samoa (from which only a single collection is known), and apparently lacking in Tonga. Without very careful examination, the specimens of this genus can readily be mistaken for *Evodia* or *Acronychia*. In our region, *Melicope* is now known from five species, four of which are here described as new. Floral differences among the species are very slight, but each has well marked vegetative characteristics.

KEY TO THE SPECIES

- Leaves 1-foliolate, the leaflet-blades ovate-oblong, 8-10 cm. long, 3.5-5 cm. broad, acuminate or cuspidate (actual apex obtuse), with numerous (12-20 per side) spreading and sharply prominulous secondary nerves; Samoa.....1. *M. lucida*.
- Leaves 3-foliolate (very rarely 1-foliolate in no. 3), the leaflet-blades usually more than 10 cm. long, with fewer than 12 secondary nerves per side (except in no. 5, with very large leaves); Fijian species.
- Leaflets comparatively small, the blades 8-17 × 2-8.5 cm., glabrous or sparsely puberulent on nerves beneath, the secondary nerves 6-12 per side; petioles rarely exceeding 10 cm. in length.
- Leaflet-blades cuspidate or acuminate at apex, not conspicuously decurrent at base on petiolules, these 2-13 mm. long; pedicels 1.5-3.5 mm. long at anthesis.
- Leaflet-blades elliptic or elliptic-obovate, 9.5-17 cm. long, 4.5-8.5 cm. broad, cuspidate to an apex 3-10 mm. long, the secondary nerves 8-12 per side; petioles usually 5-10.5 cm. long.....2. *M. homoeophylla*.
- Leaflet-blades lanceolate or oblanceolate, usually 8-12.5 cm. long and 2-4 cm. broad, gradually acuminate to an apex 10-20 mm. long, the secondary nerves 6-10 per side; petioles usually 4-6 cm. long.....3. *M. taveuniensis*.
- Leaflet-blades rounded and abruptly callose-mucronate at apex (mucro 1-2 mm. long), long-decurrent at base on petiolules 5-20 mm. long, these appearing narrowly winged; pedicels 1-2 mm. long at anthesis.....4. *M. flaviflora*.
- Leaflets large, the blades 20-40 × 10-16 cm., copiously hispidulous-puberulent beneath at least on nerves, the secondary nerves 12-17 per side; petioles 12-23 cm. long.....5. *M. robusta*.

Melicope lucida (A. Gray) comb. nov.

Pelea ? *lucida* A. Gray, Bot. U. S. Expl. Exped. 1: 348. *pl.* 34, B. 1854.
Evodia ? *lucida* Drake, Ill. Fl. Ins. Mar. Pacif. 134. 1890, non Miq. (1867).

DISTRIBUTION: Known only from the type specimen, collected on Tutuila, Samoa; no habitat or altitudinal data are available.

SAMOA: TUTUILA: U. S. Expl. Exped. (US 15034 TYPE).

This rare species, known only from the type collection, was referred to *Pelea* with doubt by Gray, who remarked: "Apparently it differs from *Melicope* only in the valvate aestivation of the corolla and the deciduous calyx, and from *Acronychia* in the uncombined ovaries. Since it is nearly in these same particulars that *Pelea* is distinguished from these two genera, the plant may most naturally be referred to the present genus, with which it pretty well accords in habit." The value of valvate as opposed to imbricate petals, in this group of genera, seems doubtful, since in other species of *Melicope*, unquestionably related to each other, the petals may be either valvate or barely imbricate or obviously imbricate. In his description of *Melicope*, Engler (in Nat. Pfl. ed. 2. 19a: 231. 1931) states, "Petals . . . imbricate or with inflexed valvate apices." *Pelea lucida* is

not listed by Engler (op. cit. 235) in his discussion of that genus, in which he includes only the various Hawaiian species and one questionable entity from Madagascar.

It appears to me that the Samoan species of *Pelea* falls into a reasonable concept of *Melicope* as defined by Engler. A final evaluation of generic lines in this part of the Rutaceae seems to be still in the future, but if reduction in the number of genera is the ultimate solution, *Pelea* A. Gray (1854) cannot compete for priority with *Melicope*, *Acronychia*, and *Evodia* (1776, all proposed by J. R. and G. Forster).

2. *Melicope homoeophylla* sp. nov.

Acronychia heterophylla sensu A. C. Sm. in Bishop Mus. Bull. 141: 75. 1936, non A. Gray.

Arbor dioica 5–10 m. alta, partibus novellis copiose puberulis, ramulis primo quadrangularibus minute pallido-puberulis mox subteretibus glabratisque; foliis oppositis trifoliolatis, petiolis leviter canaliculatis (4–) 5–10.5 cm. longis ut ramulis puberulis et glabratibus, petiolulis paullo canaliculatis terminalibus 5–13 mm. lateralibus 2–7 mm. longis; foliolorum laminis papyraceis in sicco supra fuscis subtus paullo pallidioribus, terminalibus elliptico-obovatis, lateralibus inaequilateraliter ellipticis plerumque subminoribus, 9.5–17 cm. longis, 4.5–8.5 cm. latis, basi obtusis vel acutis et in petiolulum decurrentibus, superne in apicem acutum 3–10 mm. longum cuspidatis, obscure immerso-glanduloso-punctatis, supra praeter costam basi plus minusve puberulam glabris, subtus costa parce puberulis mox glabratibus, costa supra subplana subtus prominente, nervis secundariis utrinsecus 8–12 patentibus marginem versus anastomosantibus supra planis subtus elevatis, rete venularum supra plano subtus prominulo; inflorescentiis apices ramulorum versus axillaribus late paniculatis multifloris sub anthesi 4–8 cm. longis latisque, pedunculo gracili 1–3 cm. longo, ramulis patentibus minute puberulis glabratibusque, bracteis bracteolisque minutis; pedicellis teretibus sub anthesi ♂ 3–3.5 mm. ♀ 1.5–2 mm. longis minutissime puberulis (pilis haud 0.05 mm. longis); calyce tenuiter carnosio rotato sub anthesi 2–2.5 mm. diametro eglanduloso extus puberulo 4-lobato, lobis ovato-deltoides 0.7–1 mm. longis 0.8–1.2 mm. latis subacutis; petalis 4 aestivatione valvatis subcarnosis obscure glandulosis extus parce puberulis mox glabratibus, sub anthesi oblongis vel oblongo-deltoides, 2.7–3.2 mm. longis, 1.3–2 mm. latis, apice subacutis minute cucullatis; staminibus 8 leviter inaequalibus, filamentis membranaceis ligulatis superne angustatis glabris in floribus ♂ 2.3–2.8 mm. longis (in floribus ♀ circiter 1.3 mm. et 0.8 mm. longis), antheris ellipsoideis in floribus ♂ 0.6–0.7 mm. longis (in floribus ♀ minoribus et sterilibus); disco in floribus ♂ carnosio pulvinato-obolato obscure 8-lobato 0.6–0.7 mm. alto circiter 2 mm. diametro pilis haud 0.05 mm. longis copiose hispidulopuberulo, ovarii vestigio in disco immerso puberulo lobis cum ovulis 2 abortis, styli vestigio 0.2 mm. longo glabro, stigmatibus obscure 4-lobatis; disco in floribus ♀ pulvinato obscure 8-lobato 0.4–0.5 mm. alto 1.6–1.7 mm. diametro stipitiformi ut ♂ copiose puberulo; carpellis 4 liberis,

faciebus interioribus glabris adpressis exterioribus minute hispidulo-puberulis, ovulis 2 superpositis, stylis in columnam crassam circiter 0.8 mm. longam parce puberulam connatis, stigmatibus capitato obscure 4-lobato 0.5-0.6 mm. diametro.

FIJI: VANUA LEVU: Thakaundrove-Mathuata boundary: Crest of Korotini Range, between Navitho Pass and Mt. Ndelaikoro, alt. 550-900 m., Nov. 21, 1933, *Smith 539* (Bish, GH, K, NY, UC, US 1676627 TYPE) (*ndrautolu*; tree 5 m. high, in dense forest); Thakaundrove: Southwestern slope of Mt. Mbatini, alt. 300-700 m., *Smith 632* (Bish, GH, K, NY, UC, US) (*nggarikalavu*; tree 10 m. high, in dense forest; petals and filaments white).

Since the more important generic characters occur in the pistillate flowers, no. 539 has been designated as the type; no. 632 bears staminate flowers. The two collections are quite identical in foliage, indument, perianth, etc. Another specimen which very probably belongs here is *Gillespie 130* (Bish, UC) (Viti Levu: Namosi: Summit of Mt. Naitarandamu, alt. 1250 m.), with young pistillate flowers. This differs from the Vanua Levu material in having a more pronounced and persistent indument on leaves, inflorescences, and pedicels, but it almost certainly represents *Melicope* and very likely the new species.

The new species bears a superficial resemblance to the Samoan *Acronychia heterophylla* A. Gray, from which, of course, its free carpels distinguish it. The *Melicope* further differs in the much closer indument of its disk, the less obvious glands of its filaments, and other minor floral characters.

***Melicope taveuniensis* sp. nov.**

Frutex ad 4 m. altus forsan polygamo-dioicus, partibus novellis copiose glabrido-puberulis, ramulis gracilibus superne quadrangularibus et minute puberulis mox subteretibus glabratisque; foliis oppositis 3-foliolatis raro 2-foliolatis, petiolis gracilibus supra complanatis (2-)4-6 cm. longis ut petiolulis mox glabratibus, petiolulis leviter canaliculatis subaequalibus 2-6 cm. longis; foliolorum laminis in sicco viridi-fuscis papyraceis lanceolatis vel terminalibus oblanceolatis et paullo majoribus), (6-)8-12.5 cm. longis, (1.5-)2-4 cm. latis, basi acutis et in petiolulum decurrentibus, apice acuminem 1-2 cm. longum gradatim angustatis, inconspicue immersobunduloso-punctatis, utrinque glabris vel subtus costa minute puberulis, costa supra subplana subtus prominente, nervis secundariis utrinsecus 6-10 recto-patentibus marginem versus anastomosantibus supra planis subtus revatis, rete venularum utrinque prominulo vel supra plano; inflorescentiis pedicibus ramulorum versus axillaribus paniculatis pauciramosis paucifloris, sub anthesi et fructu juvenili 3-4 cm. longis, pedunculo gracili ad 1.5 cm. longo, ramulis pedicellisque gracilibus minute et parce puberulis (pilis ad 0.05 mm. longis); pedicellis sub anthesi 2-3 mm. longis; calyce breviter carnosio cupuliformi-rotato circiter 1.5 mm. diametro extus parce puberulo 4-lobato, lobis oblongo-deltaideis circiter 0.5 mm. longis subrotatis; petalis 4 aestivatione videtur anguste imbricatis subcarnosis ovatis

circiter 1.3×1 mm. (ante anthesin) subacutis et minute cucullatis, glabris vel extus parce puberulis; florum videtur ♂ vel forsan ♀ staminibus 8 inaequalibus, filamentis subcarnosis ligulatis glabris alternatim circiter 0.5 mm. et 0.3 mm. (immaturis), antheris ellipsoideis 0.4–0.6 mm. longis abundanter fertilibus apice rotundatis; disco pulvinato minute ut ovariis puberulo; carpellis 4 liberis, faciebus exterioribus copiose minute puberulis, stylo minuto, stigmate 4-lobato, ovulis ante anthesin haud visibilibus; calyce sub fructu juvenili haud accrescente, staminibus persistentibus, filamentis longioribus ad 1.2 mm. longis, carpellis divergentibus persistenter puberulis nonnullis abortis.

FIJI: TAVEUNI: Western slope, between Somosomo and Wairiki, alt. 700–900 m., Dec. 14, 1933, *Smith 754* (Bish, GH, K, NY TYPE, UC, US) (shrub 4 m. high, in forest; flower-buds white).

Although mature flowers are not available, the advanced buds and the young fruits (with persistent perianth and stamens) show that the stamens are 8 and the carpels free, a combination of characters indicating *Melicope*. The available flowers have fertile anthers and also a well developed gynaecium, but whether or not the ovaries are fertile cannot be stated. The few available young fruits are attached to different branches, and so it is possible that I obtained material from two adjacent plants; it is more likely, however, that the flowers are perfect, since as a rule the staminate flowers of *Melicope* do not have so well formed a gynaecium.

Melicope taveuniensis is obviously a close relative of the preceding species, *M. homoeophylla*, which it resembles in fundamental characters and in leaf-texture, indument, etc. It differs primarily in its much narrower and gradually acuminate leaflet-blades and in the few other foliage characters mentioned in my key.

4. *Melicope flaviflora* sp. nov.

Frutex dioicus gracilis 2–3 m. altus, partibus novellis copiose tomentello-puberulis, ramulis juvenilibus subcomplanatis ad nodos incrassatis parce stellato-puberulis mox subteretibus glabratisque; foliis oppositis trifoliolatis, petiolis rectis supra complanatis 5–8 cm. longis et petiolulis ut ramulis puberulis glabrescentibus, petiolulis leviter canaliculatis fere ad basim anguste alatis terminalibus 10–20 mm. lateralibus 5–10 mm. longis; foliolorum laminis subcoriaceis siccitate viridi-fuscis subtus pallidioribus, obovatis vel obovato-ellipticis (lateralibus valde inaequilateralibus), 8–12.5 cm. longis, 3–5.5 cm. latis, basi attenuatis et in petiolulum longe decurrentibus, apice rotundatis et abrupte calloso-mucronatis (mucrone 1–2 mm. longo), margine anguste recurvatis, inconspicue immersoglanduloso-punctatis, utrinque praecipue costa nervisque parce stellato-puberulis mox glabratibus, costa valida supra subplana subtus prominente, nervis secundariis utrinsecus 9–12 patentibus anastomosantibus supra planis subtus elevatis, rete venularum supra immerso subtus prominulo; inflorescentiis ♀ solis visis axillaribus paniculatis multifloris sub anthesi 5–10 cm. longis 2–5 cm. latis, pedunculo (2–5 cm. longo) et ramulis

gracilibus parce stellato-puberulis, ramulis paucis patentibus, bracteis sub ramulis primariis oblongis 1–3 mm. longis, bracteis aliis bracteolisque minutis deciduis; pedicellis sub anthesi 1–2 mm. longis minute puberulis (pilis haud 0.05 mm. longis); calyce submembranaceo cupuliformi 2.3–2.5 mm. diametro extus obscure puberulo fere ad basim 4-lobato, lobis ovatis 0.8–1 mm. longis 1.3–1.5 mm. latis obtusis; petalis 4 aestivatione anguste imbricatis parce pellucido-punctatis elliptico-oblongis, submaturis 2–2.2 × 1.5 mm., apice obtusis et minute cucullatis; staminibus 8 subaequalibus, filamentis carnosis ligulatis glabris 0.4–0.5 mm. longis, antheris sterilibus ellipsoideo-ovoideis obtusis 0.5–0.6 mm. longis; disco pulvinato stipitiformi 0.2–0.3 mm. alto circiter 1.3 mm. diametro minute puberulo; carpellis 4 liberis, faciebus interioribus glabris adpressis exterioribus ut disco puberulis, ovulis 2 superpositis, stylis liberis in columnam crassam brevem haud 0.2 mm. longam inferne obscure puberulam adpressis, stigmate capitato circiter 0.8 mm. diametro profunde 4-lobato, lobis minute emarginatis.

FIJI: VITI LEVU: Mba: Ridge between Mt. Nanggaranambuluta [Lomalangi] and Mt. Namama, east of Nandarivatu, alt. 1050–1120 m., June 30, 1947, *Smith 4998* (A TYPE, US) (*kai tambua*; slender simple-stemmed shrub 2–3 m. high, in dense forest; petals pale yellow; anthers bright yellow).

Although its floral characters are essentially similar to those of the two preceding species, *M. flaviflora* is sharply characterized by its predominantly obovate leaflet-blades, which are rounded and short-callose-mucronate at apex, with gradually narrowed bases long-decurrent on comparatively long petiolules. The texture of the leaflet-blades is comparatively thick, and the indument of vegetative parts is stellate (hairs with tufted ascending branches) and fairly persistent.

55. *Melicope robusta* sp. nov.

Arbor vel frutex ad 4 m. altus dioicus (vel monoicus?), partibus novellis copiose hispidulis, ramulis robustis apicem versus 6–13 mm. diametro quadrangularibus hispidulo-puberulis demum subteretibus glabratisque; foliis oppositis magnis trifoliolatis, petiolis robustis (4–6 mm. diametro) 12–23 cm. longis basi et apice incrassatis leviter vel profunde canaliculatis persistenter hispidulo-puberulis (pilis 0.2–0.4 mm. longis); foliolis subsessilibus, petiolulis ut petiolis hispidulis terminalibus ad 3 mm. longis lateralibus subnullis; foliorum laminis subcoriaceis in sicco fusco-viridibus, obovatis vel elliptico-obovatis (lateralibus inaequilateralibus), 20–40 cm. longis, 10–16 cm. latis, basi (terminalibus) attenuatis et in petiolulum decurrentibus vel (lateralibus) late obtusis margine inferiore rotundatis, apice in acuminem gracilem 3–10 mm. longum callosum cuspidatis raro subrotundatis, margine saepe anguste recurvatis, inconspicue immerso-glanduloso-punctatis, supra praeter costam et nervos saepe puberulos mox glabrat, subtus stellato-hispidulo-puberulis (pilis albidis 0.2–0.8 mm. longis, costa nervisque persistentibus, facie demum deciduis),

costa valida supra leviter sulcata et complanata subtus valde prominente, nervis secundariis utrinsecus 12–17 irregulariter patentibus marginem versus conspicue anastomosantibus supra subplanis subtus prominentibus rete venularum supra immerso subtus prominulo copiose interconnexis; inflorescentiis late paniculatis multifloris sub anthesi ad 14 cm. longis et 10 cm. latis, pedunculo (ad 8 cm. longo) ramulisque robustis subcomplanatis copiose hispidulo-puberulis (pilis 0.2–0.4 mm. longis), bracteis sub ramulis primariis oblongis circiter 1.5 mm. longis, bracteis aliis bracteolisque minutis deciduis; pedicellis gracilibus sub anthesi et fructu 1–2 mm. longis decidue puberulis; calyce subrotato 1.5–2 mm. diametro obscure immerso-glanduloso ut pedicellis puberulo, lobis 4 ovato-deltoides 0.5–1 mm. longis 0.7–1.2 mm. latis subacutis; petalis 4 aestivatione manifeste anguste imbricatis submembranaceis conspicue glanduloso-punctatis oblongis, 1.8–2.3 mm. longis, 1–1.3 mm. latis, utrinque glabris, apice subacutis et minute cucullatis; staminibus 8 alternatim inaequalibus, filamentis membranaceis glabris ligulatis superne angustatis in floribus ♂ circiter 1.5 mm. et 1 mm. longis (in floribus ♀ 0.3–0.6 mm. longis), antheris ellipsoideis vel subdeltoides dorso obscure glanduloso-lineolatis 0.4–0.5 mm. longis (in floribus ♂ fertilibus, in ♀ similibus sed sterilibus); disco in floribus ♂ pulvinato circiter 0.3 mm. alto et 1 mm. diametro pilis haud 0.1 mm. longis copiose velutino-puberulo, ovario (videtur sterili) profunde 4-lobato ut disco piloso, styli vestigio circiter 0.2 mm. longo; disco in floribus ♀ subsimili, carpellis 4 liberis sed adpressis ubique velutino-puberulis, ovulis 2 superpositis, stylis in columnam circiter 0.8 mm. longam connatis vel basim versus liberis, stigmatibus peltato-capitato 0.4–0.5 mm. diametro 4-lobato; inflorescentiis sub fructu amplis ad 22 cm. longis latisque, perianthio staminibusque longe persistentibus, carpellis submaturis complanato-ellipsoideis ad 6 mm. longis et 5 mm. latis (nonnullis saepe abortis), angulo interiore acutis, apice rotundatis, persistenter puberulis, seminibus 2 oblique superpositis maturis non visis.

FIJI: VITI LEVU: Mba: Hills between Nggaliwana and Tumbeindreketi Creeks, east of the sawmill at Navai, alt. 725–800 m., Sept. 2, 1947, *Smith 5863* (A TYPE, US) (*sauwangga*; slender tree 3–4 m. high, in dense forest; fruit green); Naitasiri: Tamavua woods, alt. 150 m., *Gillespie 2417* (Bish, UC); Naitasiri or Rewa: Central Road, Suva district, *Tothill 214* (K); Rewa: Upper Veisari River, on trail to Nambukaluka [on Waindina River], *Horne 975* (GH, K).

DISTRIBUTION: As shown by the cited specimens, this apparently rare species is thus far known only from the forested portion of Viti Levu, at elevations from near sea-level up to 800 m. The specimen indicated as the type, of which numerous duplicates are available, bears nearly mature fruits with persistent floral remnants. The only collection with developed flowers, *Horne 975*, has either staminate (Gray Herbarium sheet) or pistillate (Kew sheet) inflorescences. It cannot be stated whether these specimens are from the same individual or from different plants, and therefore the dioecious or monoecious nature of the species remains in doubt.

Melicope robusta is one of the most easily recognized species of the

family in Fiji, characterized by its very large leaves, stout branchlets, persistent indument, etc. In leaf-texture and -shape it is suggestive of the preceding, *M. flaviflora*, but dimensional differences are striking.

DEPARTMENT OF BOTANY,
U. S. NATIONAL MUSEUM,
SMITHSONIAN INSTITUTION.

STUDIES IN THE THEACEAE, XXIII THE GENUS PELLICIERA

CLARENCE E. KOBUSKI

THE MONOTYPIC GENUS *Pelliciera* was first described in Bentham & Hooker, Gen. Pl. 1: 186. 1862, from manuscript prepared by Planchon & Triana. Later the same year, in Ann. Sci. Nat. sér. 4, 17: 380. 1862, the genus was treated by Triana & Planchon under the name "*Pelliceria*." The species *Pelliciera rhizophorae* was here introduced — also under the misspelled generic name. This error in spelling was undoubtedly a *lapsus calami*, since the genus was dedicated by Triana & Planchon to "Guillaume Pellicier évêque de Montpellier, diplomate, érudit, naturaliste, qui fut le Mécène et presque le collaborateur du célèbre Rondelet."

When originally described in Bentham & Hooker, the genus was associated with the tribe Gordoniaeae. In 1873, Baillon created a separate series, Pelliciereae [Pellicerieae] for the genus. Szyszyłowicz, in his treatment of the family for Nat. Pflanzenfam. (1893), followed Baillon's lead in placing the genus in a separate category as "V. Pelliciereae." More than thirty years later Melchior, in the second edition (1925), designated the tribe Pelliciereae.

Most taxonomists, taking into consideration the unusual habitat of the genus, have accepted it as belonging to the family Theaceae. However, this acceptance of the position of *Pelliciera* is not universal among botanists. Recent anatomists, Record (1942) and Metcalfe & Chalk (1950), suggest that *Pelliciera* should be put into a separate family. Record treated only the American genera and based his findings on the anatomy of the wood. He excluded *Pelliciera* from the Theaceae, but included *Archytaea* and *Bonnetia*, two very closely allied American genera. Metcalfe & Chalk, treating all the genera, excluded both *Pelliciera* and *Bonnetia*, designating a separate family for each genus, and included *Archytaea* and *Ploiarium*, the latter an Asiatic genus and closely related to *Archytaea*. Beauvisage (1920), cited in the literature of this family by Metcalfe & Chalk, originated the idea of separating *Pelliciera* from the Theaceae and established the family Pelliciéracées. In the course of this study I had an opportunity to discuss the problem with Prof. I. W. Bailey of our staff and was shown slides of various anatomical specimens within the family. I was impressed by the differences exhibited in the slides upon which the anatomical conclusions have been based and hasten to admit that these evidences must be taken into consideration in the future and may result in the very separation that the anatomists suggest.

Record offered no summary of his findings. He stated only that his anatomical description of the family "applies particularly to the American genera and includes all of them but *Patascoya* (not available) and

Pelliciera (described separately)." No further statement was made concerning the ultimate disposition of *Pelliciera*, which he included in the descriptions of the genera and in his prepared key to the genera. In the key it is interesting to note that *Pelliciera* was grouped and separated with *Archytaea* and *Bonnetia*.

Metcalf & Chalk based their separation of *Pelliciera* from other members of the Theaceae primarily on (1) the presence of raphides in the parenchymatous tissue, (2) the decurrent leaf-base, and (3) the almost annular structure of the vascular strand of the petiole. They suggest that the family Pellicieraceae be placed between the Marcgraviaceae and the Theaceae. The Marcgraviaceae possess raphides.

However, one should consider here the degree of separation suggested. Metcalfe & Chalk do not advocate a removal far from the Theaceae. In fact, they suggest that the proposed new family should be placed between the Theaceae and the Marcgraviaceae. This suggestion differs very little from that of the taxonomists Baillon, Szyszyłowicz, and Melchior. All these have separated *Pelliciera* from the rest of the Theaceae, each designating a separate category—practically in the same position as that suggested by the anatomist—only without the dignity of possessing a family name.

In regard to the decurrent leaf-base Metcalfe & Chalk stated that it was "unlike most of the true Theaceae." From my experience in the family it seems that the decurrent leaf-base is quite characteristic of most genera in the family, perhaps not always to the marked degree found in *Pelliciera*. In *Bonnetia*, *Archytaea*, and *Ploiarium* the base of the leaf is of the same type as that found in *Pelliciera*. Metcalfe & Chalk separate *Bonnetia* into a separate family, Bonnetiaceae, but they include *Archytaea* and *Ploiarium* in the Theaceae. In other genera the decurrent leaf-base is often present but not as pronounced as in the three mentioned above. Offhand I might mention *Adinandra*, *Camellia*, *Eurya*, *Gordonia*, *Ternstroemia*, and *Tutcheria*—to name a few genera from the various tribes of the family—where the decurrent leaf-base is considered not a bit unusual.

In discussing *Bonnetia* Metcalfe & Chalk attribute a completely closed cylindrical vascular strand to the petiole of *B. anceps* Mart. and mention other members of the genus as "exhibiting a median vascular strand which is usually crescent-shaped or almost cylindrical."

Pelliciera Planchon & Triana in Bentham & Hooker, Gen. Pl. 1: 186. 1862.—Triana & Planchon in Ann. Sci. Nat. sér. 4, 17: 380. 1862, as "*Pelliceria*."—Baillon, Hist. Pl. 4: 238. 1873, as "*Pelliceria*."—Hemsley, Biol. Centr.-Amer. 1: 96. 1879.—Szyszyłowicz in Nat. Pflanzenfam. III. 6: 192. 1893.—Solereider, Syst. Anat. Dicot. 144–154. 1899.—Beauvisage, Contrib. Etude Anat. Ternstr. 191, 450. 1920.—Melchior in Nat. Pflanzenfam. ed. 2, 21: 154. 1925.—Lemée, Dict. Gen. Phan. 5: 107. 1934.—Record in Trop. Woods 70: 31. 1942.—Metcalf & Chalk, Anat. Dicot. 1: 204. 1950.

TYPE SPECIES: *Pelliciera rhizophorae* Triana & Planchon.

Flowers hermaphroditic, solitary, axillary, included within two foliaceous involute bracts; sepals 5, imbricate, unequal, free, deciduous; petals 5, free, ligulate, much longer than the sepals; stamens 5, alternate with the petals, the filaments thread-like, closely appressed (but not adnate) within the grooves of the ovary, the anthers long, sagittate, subequal, 2-celled, dehiscent by elongated slits, the connective narrow, projected into a mucro; pistil long-conical, almost equally divided into a ridged ovary and a smooth style, the ovary imperfectly two-celled, occasionally one-celled by abortion, with a single large campylotropous ovule in each cell or with the second ovule lacking, the stigma punctiform. Fruit indehiscent, coriaceous-fungose, napiform in lateral outline, irregularly longitudinally furrowed, one-celled, one-seeded, the seed consisting solely of two large cotyledons, a firm pointed radicle, and a large curved plumule, the endosperm lacking.

Trees in mangrove swamps. Trunk buttressed at base. Leaves glabrous, disposed at the ends of the branches, coriaceous, asymmetrical, sessile, glandular-denticulate along the margin.

For its habitat, *Pelliciera* may be found in the mangrove swamps in association with *Rhizophora*, *Laguncularia*, and *Avicennia*. Its adaptation to such a habitat has brought about a definite specialization generally associated with inhabitants of mangrove swamps. The trunk of the tree flares out at the base in solid flutings as does that of *Taxodium*. From what information I have received the tree is supposed never to develop the aerial or stilt roots common in *Rhizophora*. However, in a photograph in the New York Botanical Garden of a tree isolated by clearing operations in a swamp near Balboa in the Canal Zone of Panama, evidences of stilt roots are also present near the very base. Several of my colleagues have come to the same conclusion that stilt roots are evident when confronted with the photograph. This condition may have been caused by the draining operations.

It has been generally accepted that the habitat and trunk development of *Pelliciera* is exceptional in the family. However, in *Ploiarium alternifolium* (Vahl) Melchior a similar if less extreme condition exists.

This Asiatic species is generally found growing in the sands of beaches, in the secondary jungle, especially in swampy grounds, and occasionally in mossy bogs on mountain tops. Corner (Wayside Trees of Malaya 1: 628. 1940), in recording this species, says, "In very swampy ground numerous slender stilt-roots develop from the trunk, even from a height of 8 ft., and, descending perpendicularly, they surround the trunk like a giant besom." As I mentioned elsewhere in this paper, *Pelliciera* is closely related to *Archytaea* and *Ploiarium*. I have encountered no records of such development, however, in *Archytaea*.

The fruit of *Pelliciera* is far advanced at maturity, ready for almost immediate germination, and possesses the lateral outline of a large leathery top, spongy in texture. It has been reported that the fruit drops

with the point directed toward the mud, in which it lodges ready for almost immediate development. Dr. I. M. Johnston, in his interest in this species, observed the fall of the fruit over a period of time. In his very interesting and enlightening treatment of the species in *Sargentia* 8: 207. 1949, he states that the fruit always drops with the heavy portion downward. He further states, however, that once in the water the buoyant fruit floats with the beak end downward.

The single seed, when mature, is very simple, and consists of two huge obcordate cotyledons, each measuring as much as 7 cm. across, a pointed radicle which extends into the beak of the fruit, and a curved plumule, often with two or three miniature leaves partially developed. No endosperm is present. The genus *Archytaea* is also distinctive because of the absence of endosperm.

Another character considered by some as at variance with other genera of the Theaceae is the number of stamens. One generally associates with this family a large number of stamens. In *Pelliciera* the number has been reduced to five. This seems a far cry from the multitude found in *Ternstroemia*, *Gordonia*, *Stewartia*, *Archytaea*, and *Ploiarium*. However, some genera in the family do present a low number of stamens. In these genera considerable variation may be found within any given genus, but no species has a number as low as five! A record of some of these is as follows: *Freziera* 15-30; *Adinandra* 15-60; and *Visnea* 10-21.

On the other hand, characters often seemingly of little importance show that a close relationship exists between *Pelliciera* and other genera of the Theaceae. The leaf-base, as mentioned elsewhere in this paper, is totally decurrent and very much like that found in *Archytaea*, *Ploiarium*, and *Bonnetia*. In most of the other genera of the family the leaf-base is often decurrent, but in varying degrees. The asymmetrical shape of the leaf, although far from universal, is found among species of several genera. In *Laplacea fruticosa* (Schrader) Kobuski an almost identical pattern of shape and denticulation may be found. In both instances the blade is asymmetrical and glandular denticulations are found along the upper half of the larger side of the leaf. The glandular denticulations in *Pelliciera* are more pustular in character than in *Laplacea*, but, as in all other members of the family when found they slough off or are broken off at maturity.

The long tapering ovary and style ending in a punctate stigma is typical of the family. It is obvious through dissections that reduction in the number of cells has taken place, probably a reduction from five to two cells. Dissections were made of material from both Colombia and Panama. Planchon and Triana recorded in their original manuscript five cells for the ovary (Colombia), based, I feel, solely on the fact that the floral parts were consistently in fives. Bentham and Hooker queried the five-celled ovary and reported it as two-celled. In some of my dissections only a single cell was found in the ovary, abortion of the second cell having already occurred. In other instances the second cell was

present but undeveloped and without an ovule. No ovary with five cells was found!

The ridges on the ovary have been reported as ten in number with the filaments lying in alternate grooves. The number of grooves or ridges is not always ten but close to that number. The filaments which lie pressed within the grooves are not adnate to the ovary but appear so, with the ridges pressing inward and over them during development. The filaments can be drawn from the grooves when the ovary is boiled up. I think I am right in assuming that in fresh material the filaments could likewise be easily separated from the ovary.

The ovary has been reported as pendulous and depicted as attached at the apex. My dissections showed clearly that the ovule is campylotropous, the placenta axial, and the attachment slightly below the apex of the ovule.

The developed seed, although very large, has a buff-colored mealy coating in indefinite quantity. Occasionally this coating may be lacking. This is the typical coating of many seeds in the genus *Ternstroemia*.

Pelliciera rhizophorae Triana & Planchon in Ann. Sci. Nat. sér. 4, 17: 381. 1862, as "*Pelliceria rhizophorae*."—Hemsley, Biol. Centr.-Amer. 1: 97, t. 8. 1879.—Szyszylowicz in Nat. Pflanzenfam. III. 6: 192, fig. 96. 1893.—Pittier, Prim. Fl. Costaricensis 2: 38. 1898.—Howe in Jour. New York Bot. Gard. 12: 61–72, figs. 16–23. 1911.—Melchior in Nat. Pflanzenfam. ed. 2, 21: 154, fig. 67. 1925.—Standley in Contrib. U. S. Nat. Herb. 27: (Fl. Panama Canal Zone 267). 1928; in Bot. Ser., Field Mus. Nat. Hist. 18: (Fl. Costa Rica 702). 1937.—Little in Caribbean Forester 9: 258. 1948.—Johnston in Sargentia 8: 207. 1949.

Pelliceria rhizophorae Triana & Planchon var. *β. Benthamii* Triana & Planchon in Ann. Sci. Nat. sér. 4, 17: 381. 1862.

Tree 6–15 m. high with a single trunk and elongated crown, buttressed at the base, the bark gray, roughened by conspicuous circular raised light brown lenticels 2–3 mm. in diameter; branches open, the branchlets glabrous, roughened by sharply defined leaf scars and becoming somewhat geniculate near the apex from the large protruding flower scars. Leaves glabrous, usually closely disposed at the ends of the branchlets in a seeming rosette, occasionally along the stem, sessile, coriaceous, 10–15 cm. long, 2–4 cm. wide, asymmetrical, one half appearing constantly as half an ellipse with the widest part near or below the middle, the other half wider with the widest portion usually above the middle, acute at the apex, tapering to a wide decurrent base, the midrib and veins quite inconspicuous, the margin usually entire along the smaller half of the leaf, glandular denticulate along the upper half of the wider side of the leaf when young, later apparently entire. Flowers large, showy, solitary, axillary, although seemingly terminal, sessile; the bud enveloped by two large glabrous foliaceous bracts ca. 5 cm. long and 1 cm. wide, rose-colored, coral-red or crimson; sepals 5, glabrous, imbricate, unequal,

broadly ovate to ovate, 2–2.5 cm. long, ca. 1–1.5 cm. wide, acute at the apex, concave, the median portion thickened by glandular punctations, otherwise membranaceous, the margin entire. Petals 5, free, equal or subequal, lanceolate to ligulate-lanceolate, 5–7 cm. long, ca. 1.5 cm. at the base, 0.4–0.5 cm. near the apex, blunt-pointed, usually white, occasionally pink, hyaline for the most part, thickened in the center, increasingly so in both depth and width toward the base, the margin entire. Stamens 5, 4–5 cm. long, the filaments tenuous, ca. 3.5 mm. long, closely appressed but not adnate within the longitudinal grooves of the ovary for most of their length, the anthers linear, as much as 3 cm. long, sagittate at the base, the narrow connective projected into a point at the apex. Pistil conical cylindrical, 6.5–7 cm. long, divided almost equally into a grooved ovary and a smooth style, the ovary ca. 5 mm. diameter somewhat flattened with the outer surface corrugated into approximately 10 grooves, the filaments resting in alternate grooves, 2-celled with a single large ovule in each cell, occasionally with only one cell ovulated or a single cell by abortion, the style smooth, the stigma punctate, 2-parted. Fruit napiform in lateral outline, coriaceous-fungose, 7–10 cm. long (including the attenuated beak which measures one-third to one-half the entire length), ca. 8 cm. broad and 3–4 cm. thick, reddish brown, irregularly longitudinal-furrowed, with rows of lenticel-like waxy pustules becoming pulverulent. Seed solitary consisting almost wholly of two large fleshy obcordate cotyledons as much as 6 cm. long and 7 cm. across, with a firm pointed radicle projecting into the beak, and a large curved plumule; the endosperm is lacking.

DISTRIBUTION: Mangrove swamps along Pacific coast, and islands of Costa Rica, Panamá, Colombia, and Ecuador.

COSTA RICA: Puntarenas: Punta Mala, dans les terrains inondés par la mer, *A. Tonduz* 6723 (US), March 1892 (tree).—Daquis Delta, dans les terrains inondés par la mer, *A. Tonduz* 6773 (US), March 1892 (tree).—Sandy and muddy beaches, *P. Biolley* 2026 H. P. (US), January 1907.—Sandy beaches, *P. Biolley* 17405 (G), January 1909.—Puerto Jiménez de Osa, *A. M. Brenes* 696 (Ch), April 14, 1930.—Precise locality lacking, *M. Querós* 995 (Ch), October 7, 1941.

PANAMA: Canal Zone: Banks of Rio Grande, growing in mud, *R. E. Woodson*, *P. H. Allen* & *R. J. Seibert* 762 (AA, Mo, NY), June 21, 1938 (shrubby tree 3–4 m.; calyx red; petals white).—Bella Vista, mangrove swamp, *F. M. Salvoza* 1004 (AA), September 10, 1929 (tree 2–3 m.; fruit brownish).—Balboa, on mud of estuary, *M. A. Howe* s. n. (NY), December 18, 1909.—Between Corozal and Ancon, swamp, alt. 10–30 m., *H. Pittier* 2644 (G, NY, US), February 2, 1911 (small tree 5 m.; flowers pinkish white). Prov. Panama: Rio La Maestra, mangrove swamps, alt. 0–25 m., *P. H. Allen* 32 (AA, Ch, Mo), December 4, 1936 (tree 5 m.; flowers white).—Precise locality lacking, *Bro. Heriberto* 210 (US), November 3, 1921. San Jose Island: Perlas Archipelago: Gulf of Panama (ca. 55 miles south-southeast of Balboa): mangrove swamp back of Main Beach, *I. M. Johnston* 332 (AA), 1124 (AA), October 30, 1944 and January 12, 1946 (tree 40 ft., the trunk conical at the base; flowers white; fruit husk brown, juicy but firm).

COLOMBIA: Dept. El Valle: Buenaventura Bay: mangrove thicket along bay, alt. 0-5 m., *E. P. Killip* 5222 (AA, NY, US), May 7-9, 1922 (tree 25 ft.; flowers white).—Mangrove swamp, *E. P. Killip* 34961 (US), April 13, 1939 (tree 8-10 m.; petals white).—Punta Arenas, north shore of Buenaventura Bay in mangrove swamp, sea level, *E. P. Killip & J. Cuatrecasas* 38624 (AA, US), June 2, 1944 (low shrub to tree 10 m.; calyx and petals white).

ECUADOR: Prov. Esmeraldas: Borbón, along Rio Santiago, near La Tola, mangrove swamp at water's edge, *E. L. Little* 6423 (US), May 4, 1943 (large tree to 25 m. high and 60 cm. diameter; large 1-seeded pod to 10 cm.).

This water-dispersed species is endemic to the small area of the Pacific coast of Costa Rica, Panama, Colombia, and Ecuador. From the collections studied, it seems that the most varied distribution is found in Panama, where it has been collected in the Canal Zone, Prov. of Panama, and San Jose Island. From Costa Rica six collections were studied, and all were from the beaches of Puntarenas. This appears to be the northernmost limit in the range. In Colombia only three collections were studied. These were from Buenaventura Bay and all three were collected by Killip over a period of twenty-two years. Up until 1943 the abovementioned area comprised the known distribution. In 1943 Little added to the range with his collection 6423 from the Province of Esmeraldas in the extreme northwest of Ecuador, and Johnston made two collections from San Jose Island. In Costa Rica the plant is known by the vernacular name of *mangle piñuela*, in Ecuador as *piñuela*, and in Panama as *palo de sal*.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

THE GENUS *PITTOSPORUM* IN THE SINO-INDIAN REGION*With four text-figures*

MARI GOWDA

INTRODUCTION

THE GENUS *Pittosporum*, established by Banks on material collected in New Zealand, was published in Gaertner's *Fructibus et Seminibus Plantarum* 1: 286, *t.* 59, *fig.* 7 (1788). The name is derived from the Greek *pitta*, pitch, and *sporos*, seed, alluding to the sticky pulp enveloping the seeds. In geographic distribution the plant is confined to the Old World, where it is widely spread in the tropics and the temperate areas of both the southern and the northern hemispheres. It is very abundant in Australia. Most of the species are exceedingly variable and singularly lacking in the obvious characters which are useful for quickly identifying plants. In most regions where *Pittosporum* is well represented it is recognized by systematists as a confusing and difficult genus.

This paper presents the results of an extensive study of *Pittosporum* in Asia, where the genus has had an important evolutionary center and now has its most northerly extension. The area includes not only continental Asia but also floristically similar Japan, the Bonin Islands, Ryu-Kyu, and Formosa. Most of the *Pittospora* in this area are endemic. It was not until the latter part of the 19th century that China was open to exploration by the western countries. With ample material, the product of recent explorations, I have recognized about 30 species from China.

HISTORY

The first member of the genus *Pittosporum* known to European botanists was collected by Kaempfer during his sojourn in Japan, 1690–1692. This was later illustrated and described as *Tobira* by him in *Amoenitatum Exoticarum* 5: 796, *t.* 797 (1712). No reference to this plant appears in Linnaeus' *Species Plantarum* (1753); but in Thunberg's *Flora Japonica* 99 (1784) it is described as *Evonymus Tobira*. It appeared as *Pittosporum* for the first time in Aiton's *Hortus Kewensis* ed. 2, 2: 27 (1811), where it is listed with four other species, all with brief descriptions. *Pittosporum pauciflorum* was described by Hooker & Arnott in *Botany, Beechey's Voyage* 168, *t.* 32 (1833) from the Beechey's collection of Chinese plants. In 1846 *P. glabratum*, a plant introduced to England from China, was described by Lindley in *Journal, Horticultural Society of London* 1: 230. These species are of historic importance because China

had remained a closed country for European botanical exploration until the year 1842. Previous to that time the known species of *Pittosporum* from China were all from in and around Macao and Canton. In 1886 only four species were listed by Forbes & Hemsley in *Index Florae Sinensis* 1: 58. As plant exploration proceeded, it became increasingly evident that the genus had an important center in southern and southeastern China. Seven species and one variety were recorded by Rehder in *Plantae Wilsonianae* 3: 326-330 (1917). The impetus given to botanical exploration by the opening of China to western botanists during the latter part of the 19th century and in the present one is manifest in the extensive collections distributed into various herbaria. Many of the new species of *Pittosporum* have been described during this period and reported in numerous botanical periodicals. Since the references are listed in the text with the descriptions of the species and the subsequent discussions, it seems quite unnecessary to review them here or to list them in the form of a bibliography at the end of this work.

Most of the species in India were known by the middle of the 19th century. Roxburgh described the earliest one in *Flora Indica* 2: 39 (1824) as *Celastrus*. Wight was the first botanist in that country to recognize the genus *Pittosporum*; he described three species in his *Prodromus* 1: 153-154 (1834). By the time that Hooker prepared his great work for India nine species were known, and these were briefly described by him in the *Flora of British India* 1: 198-200 (1872). As far as the Indian *Pittospora* are concerned, this is still the most valuable reference.

Among the treatments of the genus as a whole, a few are of importance to our area. De Candolle's *Prodromus* 1: 346 (1894) included eleven species, three of which occurred in the area under study. Putterlick, *Synopsis Pittosporum* (1839), reviewed and enumerated 36 species, of which nine were found in our area. Pritzel's treatment of the family Pittosporaceae in Engler and Prantl, *Die Natürlichen Pflanzenfamilien*, ed. 2, 18a: 265-286 (1930), dealt mostly with the general aspects of the genus and gave a synopsis of all the species occurring in all the regions. It is, indeed, the most important item in the extensive bibliography of the genus.

MATERIALS

The main source of materials on which this study is based is the vast collections of *Pittosporum* from China and India which have accumulated in the herbarium of the Arnold Arboretum. These have been supplemented by loans from the Gray Herbarium, from the New York Botanical Garden, and from the Sibpur Botanic Garden, Calcutta, India. Several type specimens have been obtained from the herbarium of the Royal Botanic Garden, Kew, England. In citing specimens from the above herbaria the following symbols have been employed: (A) = Arnold Arboretum; (GH) = Gray Herbarium; (NY) = New York Botanical Garden; (C) = Sibpur Botanic Garden; and (K) = Kew.

ACKNOWLEDGMENTS

This study was begun in the Herbarium of the Arnold Arboretum during my enrollment as a graduate student in Harvard University, and I wish to offer my sincere thanks to the authorities of the University for accepting me for graduate study, and to the Government of Mysore for deputing me for two years' study (1949-1950) in America; and I am especially grateful to Sri H. C. Dasappa, Finance Minister of the Government of Mysore, for allowing me to come to Harvard University.

I wish to express my deep gratitude to Professor I. M. Johnston, the sponsor of my study, under whose supervision and guidance this paper has been prepared, and to Professor I. W. Bailey for his guidance and help in the study of pollen analysis. I am thankful to Professor E. D. Merrill for his help on numerous occasions. I should like to express my indebtedness to the directors and curators of the several herbaria mentioned above for loaning the materials for this study. My thanks are also due to Mrs. Lazella Schwarten, librarian at the Arnold Arboretum, for all her help in the library. I have received unrestrained and spontaneously kind treatment from all the staff in the Arboretum, the Bussey Institute, and the Biological Laboratory, for which I wish to record here my everlasting remembrance of their kindness.

MORPHOLOGY AND TAXONOMIC CRITERIA

General habit: The Asiatic species are small trees or shrubs. They are mostly upright, but a few, such as *P. heterophyllum* var. *sessile* and *P. saxicola*, are low and spreading. Young shoots in several species and especially in *P. eriocarpum*, *P. ferrugineum*, and *P. formosanum*, are covered with dense induments but later become glabrescent; most species, however, are glabrous even when young. In herbarium specimens the twigs are usually brown to brownish grey and commonly speckled with small whitish lenticels. In *P. parvifolium*, however, the lenticels become very prominent collar-like slits on the bark. Similar collar-like lenticels are prominent on the pedicels of the fruit in *P. gagnepainianum*. Leaf-veins vary in size according to the stoutness of the petioles. In shape they are roundish to reniform and often more or less triangular. All show the marks of three vascular bundles. These features are of minor value and of little use in the classification of the Asiatic species of the genus. Branching usually is either simple or verticillate. The behavior of the leading shoot may be described as follows:

1. Vegetative in the first year.

- a. Producing terminal leafy inflorescences the second year and also a new leading vegetative shoot or shoots from the lower axils;
or
- b. Producing leafless pseudoterminal inflorescences the second year from the buds congested at the apex, and also a new leading vegetative shoot or shoots.

2. Vegetative and terminating in an inflorescence the first year, and the second year producing a new leading vegetative shoot or shoots from its lower axils.

Leaves: The leaves of *P. truncatum* var. *tsaii* are always somewhat lobed, as are also occasional leaves in specimens of *P. kerrii* from Upper Burma. Other species, however, all have entire leaves. In all species the actual margin of the leaf is edged by a distinct colourless thick cuticle. In size and shape the leaves are variable, often within the species. In average size they may vary from 2 cm. to over 25 cm. long. *Pittosporum adaphniphylloides*, *P. daphniphylloides*, and *P. napaulensis* are notable among our species for their large oblong leaves. *Pittosporum adaphniphylloides* has the largest ones, these often measuring over 25 cm. in length. The smallest and narrowest leaves, among the Asiatic species, are possessed by *P. saxicola*. In *P. truncatum* the leaves are obovate with an abruptly acute apex. It should be noted that *P. heterophyllum* has leaves obovate and abruptly acute as well as oblanceolate. Broadly oblanceolate leaves are characteristic of many species. Small, narrowly lanceolate leaves are possessed by *P. humile* and *P. pulchrum*, while much larger leaves of similar outline are found in *P. glabratum* var. *neriifolium*, *P. podocarpum* var. *angustatum*, *P. oblongilimbum*, and *P. pentandrum*. Broadly obovate leaves are common to many species, such as *P. sahnianum*, *P. kerrii*, *P. floribundum*, and *P. glabratum*. There is accordingly great variation in size and shape, from small to large, and from linear and oblong through lanceolate and elliptic to ovate or obovate. In spite of such variation, the leaf-shape, combined with various types of leaf-apex, provides very useful characters for species recognition in this region. Such closely related and intergrading species as *P. balansae*, *P. confertum*, and *P. baileyianum* can usually be recognized solely by their distinctive leaf-shapes.

In nearly all of our species the leaves are glabrous or glabrescent, the chief exception being *P. eriocarpum*, which has dense and permanently tomentose foliage. The indument of this latter species is composed of characteristic yellowish brown hairs which densely clothe the leaves and the young twigs. This distinctive pubescence provides a character by which the species may easily be distinguished from all other Sino-Indian congeners. Conspicuous rusty hairs are present on young leaves and shoots of *P. ferrugineum*. On older leaves, however, these hairs are deciduous and leave small projecting cutinized basal cells that appear stump-like when the cuticular epidermis is prepared and observed under high magnification. In *P. baileyianum* and *P. balansae* brown or blackish brown hairs may persist along the veins on the older leaves.

The colour of the leaves on the dried specimens in a few species departs from a nondescript brown and becomes distinctive. In *P. kobuskianum* it is pale green. In *P. napaulense*, *P. ferrugineum*, and *P. kerrii*, it is dark deep brown. Phyllotaxy is frequently obscured due to the tendency of the leaves to crowd towards the ends of the branches. On all elongating

shoots the lower leaves are loosely arranged and clearly alternate. Upwards along the shoot, by gradual transition, the leaves become more closely spaced, and towards the ends of shoots they are decidedly crowded. This crowding of the leaves (towards the ends of the branches) is caused by suppression of the internodes and not by crowding of many leaves at a node. Most important, it results in the congestion of axillary buds and eventually in verticillate branches, a characteristic feature of all our species.

Petioles: The petioles are very short. They may be suppressed or up to 3 cm. long. In *P. heterophyllum* var. *sessile* the leaves are sessile; in *P. saxicola* they are subsessile. Petioles vary in the rest of the species. The average length is from 5 to 15 mm. The length of the petiole generally decreases from the lower leaves upwards or *vice versa*. Hence their length is of little value in classification. The petioles may be either slender or stout and they vary in this regard within the species. They are rounded on the lower surface. On the upper surface they are channeled, with the edges slightly winged due to the decurrent margin of the blade.

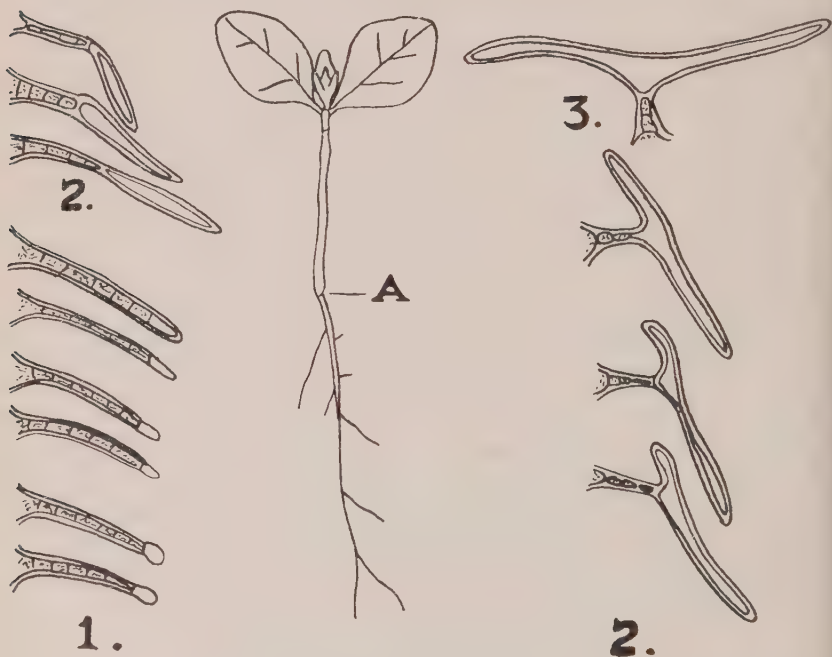
Midrib and veins: The convex midrib is always prominent on the lower surface of the leaf. The veins may be evident or obscure, though they are usually prominent on the lower leaf-face. In number they are not characteristic of any species or group of related species. In our region the most distinctive veins are found in *P. nervosum*. In that species they are prolonged to form a distinct submarginal vein on the lower face. A similar development is found in *P. perryanum* and occasionally in *P. napaulense*.

Veinlets and areolae: On the lower surface of the leaf the veinlets may vary from slightly emersed to prominent. They are never prominent on the upper surface. The areolae formed by the veinlets are more or less isodiametric and may vary in size from species to species. They are extremely small in *P. pauciflorum* and very big in *P. perryanum*. In *P. terrii*, *P. adaphniphylloides*, and *P. napaulense* they may be very conspicuous because of the prominence of the veinlets forming their margins. In many species they frequently contain one or more free ends of veinlets. These developments, however, are rarely constant in a species and may be ecological in origin.

Indument: The different variations of trichomes characteristic of the genus are all well displayed on the hypocotyl and the epicotyl of the young seedling of *P. tobira*. On a seedling 6 cm. long and about three months old the changes in the number of cells and in the shape of the apical cell of the trichome are remarkable and very interesting. Between the ground level and the cotyledons the hairs are all simple, uniseriate, and of equal length. The lowest hairs are 8-celled and have their apical cell small and rounded. Those occurring higher up along the hypocotyl have their cell numbers gradually reduced to 5 or 6. The length of the trichomes remains the same by proportional increase in the length of the apical cell. Above

the cotyledons further changes occur. The 4- or 5-celled trichomes on the epicotyl show every transition from simple form to T-shaped. This results from the apical cell changing its orientation, becoming more and more clearly branched at the bent base, and gradually lengthening horizontally from the bend to form another arm of the T-shaped trichome. Every transition from straight to bent, from unequal to equal arms is exhibited. In the seedling studied, therefore, there is complete transition, within 6 cm. from the ground level to the tip of the epicotyl, from 8-6-celled uniseriate trichomes to 6-3-celled T-shaped trichomes. All the series of changes in the apical cell that finally produce the T-shape take place within the epicotyl, which is hardly over 1 cm. long.

On the herbarium specimens studied no glandular hairs were observed, and straight hairs were infrequent. The common type of trichomes is T-shaped. These may have unequal to equal arms. The average basal stalk-cells number 6-3. The extreme reduction occurs in *P. nervosum*,



TEXT-FIGURE 1. *Pittosporum tobira*: FIG. A. Three-month-old seedling. FIG. 1. Trichomes on the hypocotyl. FIGS. 2, 3. Trichomes on the epicotyl and leaves.

where the stalk-cells in the trichome number 1 or 2 and the arms are short and blunt. Plants with this condition appear almost completely glabrous to the naked eye. Species like *P. eriocarpum* and *P. ferrugineum* are thickly covered with T-shaped trichomes. In *P. eriocarpum* the arms of

the hairs are very long and interwoven. They form a cobweb-like canopy supported by stalks which are long and 6-celled. The basal cell of the stalk, both in *P. ferrugineum* and *P. eriocarpum* is thickly cutinized and continuous with the epidermis. When the trichomes break off these basal cutinized cells remain and under a microscope appear stump-like on the epidermis. When an indument is present, the T-shaped trichomes with equal arms are the type prevailing on the leaves, on the young stems, and on the inflorescences.

On the ovary the trichomes have unequal arms borne on a short stalk. The shorter arm is usually blunt and directed towards the base of the ovary. The longer arm is always directed towards the apex of the ovary. Uniseriate short straight hairs with small rounded apical cells are sometimes developed on the margin of sepals. The density, the persistence, and the colour of the indument are not uniform and constant except in a few species like *P. eriocarpum* and *P. ferrugineum*. Such characters appear to be of little or no value in the recognition of species.

Epidermal cells: The leaf cleared in the sodium hydroxide solution, or epidermis prepared by the maceration method with Sudan IV staining, shows, under high magnification, epidermal cells either angulate with polyhedrous outline or irregular with an undulate outline. The former type is found in species like *P. dasycaulon*, *P. eriocarpum*, and also in *P. neelgherrense*, *P. napaulense*, *P. floribundum*, *P. brevicalyx*, *P. ceylanicum*, *P. truncatum*, *P. heterophyllum*, and *P. saxicola*, and the undulate outline is well illustrated in *P. nervosum*. Among closely related species the size and outline of the epidermal cells may remain relatively constant, even though the whole leaf may differ greatly in size and outline. This is clearly shown in the following comparison:

SPECIES	LEAF SIZE (in millimeters)		STOMATAL SIZE (microns)		EPIDERMAL CELL SIZE (microns)
	Length	Width	Length	Width	
<i>P. truncatum</i> China Henry 5513	60	20	23-30	21-22	22-30
<i>P. heterophyllum</i> China Schneider 1346	40	10	21-30	21-24	21-32
<i>P. saxicola</i> China Wilson 3182	15	5	33-40	20-30	20-40

Striate leaf-cuticle was observed in most of the species examined. The striations are made up of granular bead-like thickenings. They follow the outline of the epidermal cells and also radiate out from the larger

stomata and from the persistent bases of deciduous trichomes. *Pittosporum eriocarpum*, *P. napaulense*, and *P. ferrugineum* illustrate this particularly well.

The stomata show slight differences in size and also in the number per given area, but are otherwise constant. They are of the rubiaceous type. The oxalate crystals are needle-like. They can occur singly or in bundles in one and the same leaf in some species.

The leaf apex: Among the TRIVALVAE, members of the tobira-complex have leaves with an obtuse, rounded, and often emarginate apex. On the other hand, those of the glabratum-complex of the TRIVALVAE all have the apex acute or acuminate. Among the BIVALVAE, *P. viburnifolium* and *P. ceylanicum* are characterized by an obtuse or rounded apex. In *P. heterophyllum*, *P. saxicola*, and *P. humile*, as well as in *P. truncatum*, the apex is minutely apiculate. *Pittosporum johnstonianum* and *P. chatterjeeanum* are characterized by a long-acuminate apex. *Pittosporum sahnianum* and some specimens of *P. kerrii* have characteristically stouter, as well as shorter, somewhat curved apical prolongation.

Though varying in a few species, in general the apex is the most useful and constant vegetative character in defining the species. Indeed, in our region the species with 3-valved capsules may be divided into two convenient and very natural groups on the apex-shape alone.

Inflorescence: The inflorescence is determinate in development. Its cymose clusters show great diversity in degree of branching. Since there is much confusion in the use of terms describing such inflorescence, the following terminology has been adopted:

1. Terminal; primarily floriferous shoots or single flowers produced apically on the stem and branches. These terminate by flowers and produce no terminal bud for future elongation. This type of inflorescence may be classified as follows:
 - a. Panicle type.
 - b. Compound-corymbose type.
 - c. Solitary flowers.
2. Pseudoterminal: developing directly from buds crowded about the apex of the shoot of the previous season.
 - a. Compound-umbellate type.
 - b. Sub-umbellate (cymose-cluster) type.
 - c. Umbellate (cluster of single flowers) type.
 - d. Solitary flowers.
 - e. Solitary cymes.
3. Lateral: arising from axillary buds along the shoot.
 - a. Axillary: subtended by well-developed leaves and arising directly from the axil or from axillary short shoots.
 - b. Intercalary: subtended by bracts or very reduced leaves; and produced along a leafy young shoot. The shoot bears most of the well-developed leaves towards its apex and is terminated by a vegetative bud.
 - c. Caulifloral inflorescences: produced on older leafless stems.

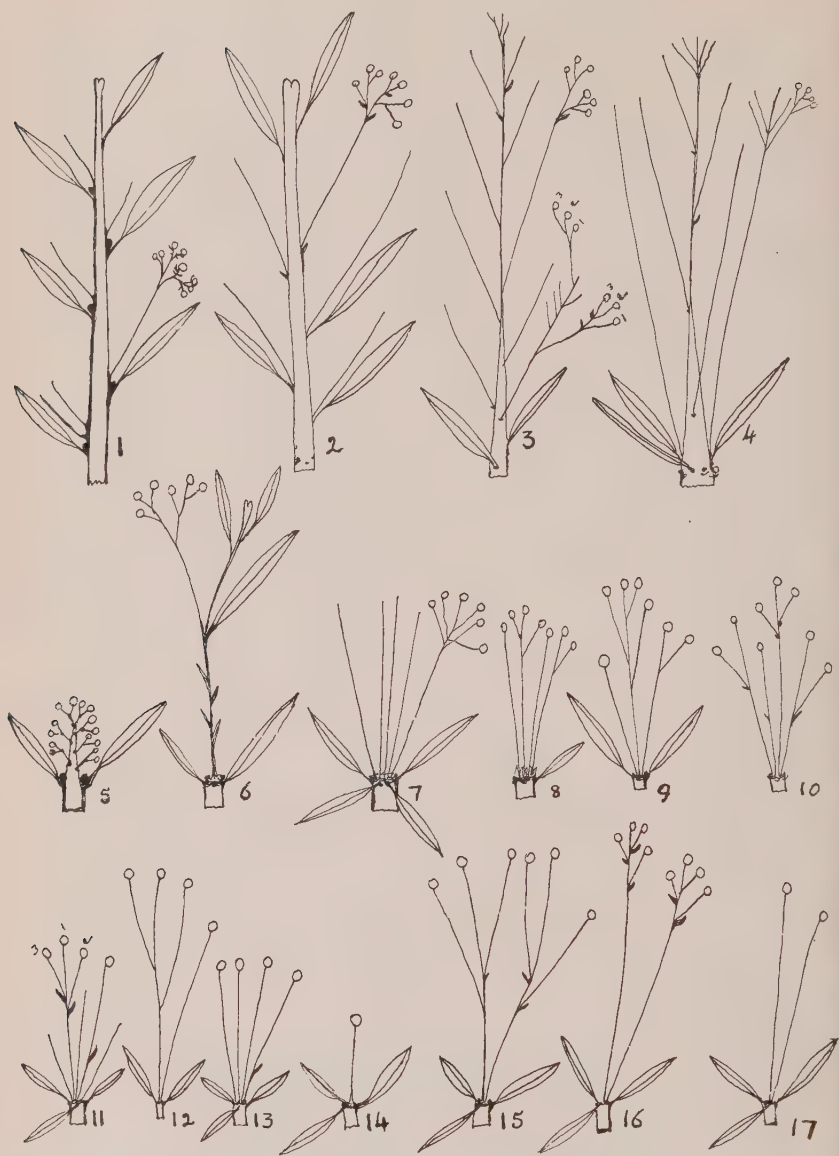
4. Supra-axillary inflorescences: arising from the uppermost of the supernumerary axillary buds and hence a few millimeters above the subtending petioles.

One or more of these types of inflorescence may occur in individual species or in a group of species. In *P. kerrii* terminal and intercalary are both developed; the former, however, predominates. *Pittosporum formosanum* and *P. formosanum* var. *hainanense* have only terminal inflorescences. Within *P. napaulense*, *P. floribundum*, and *P. brevicalyx* individual plants may have either terminal or pseudoterminal inflorescences. *Pittosporum johnstonianum*, *P. adaphniphyloides*, *P. daphniphyloides*, *P. viburnifolium*, and most of the TRIVALVAE are characterized by a pseudoterminal inflorescence. Speaking generally, we may say that the terminal and pseudoterminal types are most common among the species in our area. The most extreme and uncommon type is supra-axillary, found only in *P. nervosum*.

The amount of branching in the inflorescences is very variable, within a single species as well as in a series of related species. In the well-branched paniculate inflorescences the ultimate cymules are one- to many-flowered. The rays of the inflorescence may be compounded more than three times. The inflorescences, indeed, may be very complicated, often showing the fourth or fifth degree of branching. In gross appearance they may be more or less paniculate (*P. napaulense*, *P. floribundum*, *P. brevicalyx*), or compound-corymbose and pyramidal (*P. formosanum* and *P. kerrii*), or compound-umbellate (*P. johnstonianum*, *P. viburnifolium*, *P. adaphniphyloides*, *P. daphniphyloides*), or subumbellate (most of the TRIVALVAE), or umbellate (*P. sahnianum*, *P. pauciflorum*, *P. parvifolium*).

There are ample indications that the trend of inflorescence evolution in the genus is from the well-branched paniculate to the simple cymose type and eventually to the solitary flower, with all intermediary stages present. A suppression of the internodes in the main axis of the paniculate or compound-corymbose types would produce a compound-umbellate inflorescence such as that exemplified in *P. johnstonianum*, *P. adaphniphyloides*, and *P. viburnifolium*. By a reduction in the number of rays and of flowers, such compound umbels can be transformed into the clustered cymes characteristic of the TRIVALVAE. All the TRIVALVAE of our region, along with some of the BIVALVAE, have aggregations of cymes of various complexity. In gross appearance these aggregations may be subumbellate or umbellate. In a few cases (*P. parvifolium*, *P. pauciflorum*, and *P. sahnianum*), the cymes are very reduced and the aggregation becomes merely a sessile umbel of flowers. *Pittosporum oligocarpum* has a solitary cyme, very simply organized. In species with polygamodioecious flowers, as *P. glabratum* and *P. podocarpum*, the flowers with short stamens are solitary, whereas those with long stamens are umbellate. The solitary flowers, where found, are evidently the result of extreme reduction. They are cymes reduced to the ultimate.

The precise stages in the development of single flowers, whether in an



TEXT-FIGURE 2. Inflorescences: FIG. 1. Supra-axillary. FIG. 2. Intercalary. FIGS. 3-5. Terminal. FIGS. 6-17. Pseudoterminal.

FIG. 1. *Pittosporum nervosum*. FIGS. 2, 3. *P. floribundum*, *P. kerrii*. FIG. 3. *P. formosanum* and var. *hainanense*. FIGS. 3, 4. *P. napaulense*. FIG. 5. *P. merrillianum*. FIG. 6. *P. podocarpum*. FIG. 7. *P. johnstonianum*. FIGS. 8-11. *P. tobira*. FIG. 9. *P. truncatum*. FIG. 12. *P. oligocarpum*. FIG. 13. *P. sahnianum*, *P. pauciflorum*. FIG. 14. *P. lignilobum*, *P. podocarpum*, *P. glabratum*, *P. crispulum*. FIG. 15. *P. chichijimense*. FIG. 16. *P. boninense*. FIG. 17. *P. parvifolium*.

umbel or solitary, merit some discussion. An umbel of single flowers could be produced by a reduction of the inflorescence in two ways: by the suppression of the primary axis of a simple, loosely branched cyme; or by reducing each cyme in a cluster of cymes to a single flower. The latter appears to be the case in our species. In most of the TRIVALVAE, the clusters of cymes show various reductions from many-flowered cymes to few-flowered ones and finally to single flowers. In many species of this group the cymose cluster is composed of 4-flowered, 3-flowered, 2-flowered, and even 1-flowered cymes. If all the cymes in the cluster were reduced to 1-flowered cymes, the result would be an umbel of single flowers. The bractlets present on the support of single flowers clearly indicate the suppression of lateral flowers in the cyme. This elimination or suppression of lateral flowers in a cyme, to produce a single flower, is well illustrated in the three endemics of the Bonin Islands. *Pittosporum Michijimense* is characterized by short-peduncled and long-pedicelled cymes in the cluster; *P. boninense* by long-peduncled and short-pedicelled cymes; and finally, *P. parvifolium* by long-pedicelled flowers in the umbel. The umbel in our species, where found, seems to be thus the result of reduction of the cymose cluster. The extreme reduction of both the cluster and cymes could result in a solitary flower. The collar-like bracts, occasionally found at the base of the pedicel of a solitary flower, probably give such indication, since they appear to be the reduced bracts of an axis whose internodes have been completely suppressed. Pedicels that arise directly from the apex of the shoot and show no external indication of suppression could be reduced cymes, since reduction seems to be the trend in our species.

Bracts and bractlets: The bracts show great variation in size and shape. In size they vary from almost the normal size of the leaf to minute. This gradation in size is very well illustrated by observing the bracts on the axis of the inflorescence of *P. formosanum*. Here the lower bracts are almost as large as the leaves; higher up they are smaller (2–3 mm. long), until at the apex they are minute. Most of the species, however, have small bracts, usually 10–20 mm. long. But the presence or absence of these bracts and their persistence, when present, are all very variable within the species.

There are scaly or membranous structures which occur in collar-like clusters at the base of young shoots or young shoots bearing inflorescences. Such a collar of extremely small bracts sometimes occurs at the base of the pedicel of a solitary flower in some species. In *P. truncatum* it often is present at the base of the young shoot bearing an inflorescence. Likewise it is present in *P. tobira* and some others. In some species these bud-bracts are deciduous and drop off very early, leaving scars at the base of the shoot.

In a few species there are small prophyll-like structures, and in *P. nervosum* somewhat bracteole-like structures which merit a few words of explanation. *Pittosporum nervosum* has one or two small bracteoles

(?) at the base of the calyx; and on the short pedicels there are one or two prophyll-like structures. The latter often occur, also, on the supports of solitary or single flowers in the umbellate clusters. The prophyll-like structures are probably the bractlets of a cyme in which the lateral flowers have been suppressed.

Pedicels and fruit-stalks: The length of the pedicels in a solitary flower or in an aggregation of single flowers varies from 5 to 50 mm. *Pittosporum parvifolium* has the longest pedicels among the single-flowered species, and the next longest are in *P. sahnianum*. In most of the species, however, the length is variable.

The length of the pedicels in cymes and in well-branched inflorescences varies from 0 to 60 mm. The pedicel is very reduced in *P. confertum* and is extremely short in *P. nervosum*. It is 40–60 mm. long in *P. chichijimense*, but in most of our species with well-branched inflorescences it is usually 0–10 mm. long; and this latter variation in the length of the pedicel usually occurs in the same inflorescence.

Pedicels at the time of flowering show very slight differences in their thickness. The slenderest are in *P. oligocarpum*, where they are almost filiform. In most of the species they are usually about 1 mm. thick. The pedicels or supports of the capsules, in some of our species, show greater variations in thickness. From flowering to the maturing of the fruit several of our species take over six months; and during that period considerable growth takes place in peduncles and pedicels. Undoubtedly this is the reason for the variation in their thickness. Furthermore, the support of a solitary capsule is often composed partially of peduncle and partially of pedicel, for the cymes may mature only one fruit. Accordingly, I have used the term "fruit-stalk" for the supports of capsules, since it may be a pedicel or a composite structure composed of peduncle and pedicel.

Flowers: The flower-buds in most of our species are oblong. A few species, *P. baileyianum*, *P. balansae*, *P. confertum*, *P. ferrugineum*, *P. undulatum*, and *P. neelgherrense*, have ovate buds.

According to field reports, most of our species bear fragrant flowers. Some of them are prized garden shrubs in tropical and subtropical gardens.

Sepals: Speaking in general, the sepals in most of our species are either free or slightly connate at base. The exceptional cases are *P. nervosum* with a shallow cup-like calyx and *P. undulatum* with a long calyx-tube which splits into two parts, one 2-lobed and the other 3-lobed. The sepals are usually membranous, but in *P. formosanum* they are somewhat coriaceous. They vary in size from 1 mm. to about 9 mm. long. Most of the species in TRIVALVAE have short sepals, usually 2–4 mm. long (with the exception of *P. subulisepalum*, which has been said to have sepals 7 mm. long, and *P. pauciflorum*, with sepals 4–5 mm. long). Among the members of BIVALVAE, the species of the undulatum-complex bear long sepals, usually 4–9 mm. long, and those of the balansae-complex have sepals 4–5 mm. long. The rest of the BIVALVAE have short sepals, usually 1–4 mm. long.

Sepals are either glabrous or hairy. Long sepals are usually hairy. Short sepals are usually glabrous, but the margin may be ciliate or fringed with hairs. The margin in most cases is membranous, or membranous and ciliate.

The shape of the sepals varies considerably. In some species it is oblong with rounded apex and with non-membranous margin, as exemplified in *P. formosanum*. In others it is oblong with obtuse or acute apex and with membranous margin, as exemplified in *P. napaulense*, *P. floribundum*, *P. kerrii*. In most of the members of TRIVALVAE it is triangular or ovate with broad base and with obtuse or acute apex. In almost all of the species bearing long sepals, the shape is usually lanceolate with acuminate apex.

In the species which bear short sepals (1–4 mm. long) there is considerable variation both in shape and size within the species, hence the sepals are of little or no help in classification. The long sepals (4–9 mm. long), however, characterize individual species or a group of species in our area, and they are of great help in delineating the species-complexes as well as individual species.

Petals: The petals, variable as to size, are usually uniform in shape. They are obovate-oblong or oblanceolate, with obtuse or rounded apex. The lower halves of the petals are erect and, whether slightly connate or not, form the tube-like part of the corolla; their upper halves, their broadest part, are imbricate in the bud and spreading at anthesis. In size the petals vary from 5 to 15 mm. long. The size varies greatly within the species, particularly in those species which are characterized by dimorphic flowers. In *P. nervosum* the petals bear a few short T-shaped trichomes on the outer surface. In other species, however, they are glabrous. According to the field reports, the colour of the petals is yellow or, exceptionally, white.

Floral dimorphism: All our species produce hermaphrodite flowers, but a tendency for the separation of sexes has been observed in several species. Indeed, the unisexual stage has been reached in some specimens of *P. undulatum*. Furthermore, the floral dimorphism observable in some of our species illustrates some of the earlier evolutionary stages in the same direction. This tendency towards unisexuality, observable in the genus, has not attracted much attention on the part of the botanists. No field observations bearing on it are available for our area.

Most of the species bear monomorphic, hermaphrodite flowers. In these the tips of the anthers usually reach to the level of the stigma or only slightly beyond it. Over ten per cent of the species bear two types of flowers. These have marked structural and functional differences and may occur on different plants or on separate twigs on the same plant. One of them has long stamens and is potentially male. The other has short stamens and is potentially female. The long-stamened flowers are superficially similar to those borne by species producing only a single type

of flower. Their anthers are always fertile and their tips reach the stigma or slightly beyond it. Their ovary, however, is slender and cylindrical (rather than plump) and, most important, tends to be infertile. Flowers of this type and also those with short stamens are regularly developed by such species as *P. glabratum*, *P. podocarpum*, *P. ferrugineum*, *P. illicioides*, and *P. crispulum*. From species to species short-stamened flowers appear with various modifications. They may possess stamens with poorly developed anthers, the tips of which reach only partly up the style (e. g., some specimens of *P. sahnianum* and *P. heterophyllum*). In *P. glabratum*, *P. podocarpum*, *P. illicioides*, *P. ferrugineum*, and *P. crispulum*, the filaments as well as the anthers may be poorly developed and both appressed to and hardly surpassing the body of the ovary. The anthers are abortive and sterile. An ultimate stage of reduction is found in those flowers in which the stamens are represented only by gland-like structures (*P. undulatum*). In such short-stamened flowers the ovary becomes correspondingly more and more plump and fertile, and the flower as a whole more and more distinctly female.

These tendencies are expressed in one stage or the other in many species other than those cited above. They are not restricted to any one geographic area. Collections of Wilson and of Dummer from Uganda, Africa, belonging to *P. ripicola* Leonard, Bull. Jard. Bot. Bruxelles 20: 47 (1950), illustrate it. Wilson's collections bear flowers with short stamens in which the filaments hardly surpass the ovary and the anthers are abortive; whereas Dummer's collection bears long-stamened flowers with perfect anthers. In *P. ferrugineum*, the specimens from Malaysia exhibit the same conditions. Koorders & Valetton, Boomsoorten Java, Bijdrage 4: 54 (1896), mentioned the floral dimorphism in that species. *Pittosporum undulatum* I have mentioned previously. It appears that this floral dimorphism is widespread among the members of the genus. It is probable also that more than one of the modifications in the flower can occur in one and the same species. Hamilton, Proc. Linn. Soc. New South Wales ser. 2, 19: 583-4 (1894), has observed short stamens with abortive anthers in *P. undulatum*, and I have seen stamens completely reduced to gland-like structures in the same species.

It is to be noted that the floral dimorphism described is not heterostyly. There is no inverse lengthening or shortening of styles to correspond with the short and long stamens. The ovary may vary in fertility, but the style-length remains constant. The conspicuous differences in the two types of flowers are chiefly those of the stamens.

The following correlations associated with the floral dimorphism in the genus are noteworthy:

1. Among the *glabratum*-complex, in the species characterized by dimorphic flowers, the short-stamened flowers are robust and are borne usually solitary, in single-flowered inflorescence; whereas the long-stamened flowers are slender and are borne in clusters.

2. In *P. ferrugineum* there is no difference in the form of inflorescence,

but there are differences in the flower-buds. The buds of short-stamened flowers are usually conical and short. Those of the long-stamened flowers are cylindrical at the base, dilated above the middle, and conical at the apex, and are usually longer.

3. In such species as *P. sahnianum* and *P. ripicola*, the long- and short-stamened flowers are similar in form and occur in similar inflorescences.

Pollen-grains: Concerning the pollen morphology of the family very little has been recorded. Wodehouse and Erdtman say nothing of this family. Fritzsche, Beitr. Kenn. Pollen 25 (1832), merely lists *P. undulatum* as having smooth grains. Mohl, Ann. Sci. Nat. Bot. sér. 2, 3: 338 (1835), though he mentions the pollen of only *P. undulatum*, merely remarks that it resembles that in the Aquifoliaceae. Schnizlein, Kerr. Fam. Nat. Veg. 4: t. 234, f. 9-10 (1870), gives figures of pollen-grains of *P. undulatum*, but the figures are non-informative. The measurements of pollen-grains of *P. undulatum* and *Sollya heterophylla* are given by Edgeworth, Pollen, ed. 2, 64 and 89, t. 22, f. 373 (1877), as "8-9/6000" (about 33 microns). He describes them as "pale yellow, elliptic, with 3-bands and slits . . ." Selling, Stud. Hawaii. Pollen Stat. part 2 in Bish. Mus. Sp. Publ. 38: 130-132 (1947), reports on two Hawaiian species.

<i>Billardiera scandens</i> ,	28-31 microns	<i>Pittosporum</i>	
<i>Bursaria spinosa</i> ,	15-18	<i>eriocarpum</i> ,	24-27 microns
<i>Cheiranthra linearis</i> ,	30-36	<i>P. floribundum</i> ,	27-30
<i>Hymenosporum</i>		<i>P. glabratum</i> ,	35-40
<i>flavum</i> ,	40-45	<i>P. heterophyllum</i> ,	33
<i>Marianthus candidus</i> ,	30-31	<i>P. mannii</i> ,	24-27
<i>Pittosporum</i>		<i>P. neelgherrense</i> ,	31-34
<i>baileyianum</i> ,	30-33	<i>P. oblongilimbum</i> ,	47-50
<i>P. balansae</i> ,	30-34	<i>P. rehderianum</i> ,	40-42
<i>P. ceylanicum</i> ,	31-33	<i>P. saxicola</i> ,	27-30
<i>P. crispulum</i> ,	40-50	<i>P. tobira</i> ,	31-34
<i>P. daphniphylloides</i> ,	33-38	<i>P. truncatum</i> ,	27-30
<i>P. dasycaulon</i> ,	32-34	<i>Pronaya elegans</i> ,	27-30
		<i>Sollya heterophylla</i> ,	31-34

I have studied a representative of all the genera in the family and about 26 species of the genus *Pittosporum*. Preparation of the pollen was by the acetolysis method [Erdtman, G. Introd. Poll. Analysis 29 (1943)]. All descriptions of the sculpturing of the exine was from these mounts so prepared. Measurements of the grains were averaged, based on the permanent mounts supplemented by 30 temporary ones prepared with lactic acid.

The Pittosporaceae are characterized by "small" and "medium" size grains. The smallest noted is 15-18 microns. The largest is 45-50

microns. All intermediate sizes may be found. The prevailing size in most species, however, is between 30 and 40 microns. The grains are spherical to oblongish and all are tricolpate, rarely tetracolpate (Selling l.c.). The furrows converge and taper. The germ-pores are in the equatorial regions of furrows. The reticulate sculpturing of exine is made up of granular thickenings. The average size and structure of the grains in 25 species may be summarized as follows: Tricolpate, grain-size 15 to 50 microns, roundish to oblongish; germ-pore in the middle of the germ-furrows; exine coarsely reticulate through faintly reticulate to almost smooth (inconspicuously reticulate).

Ovary: The ovaries in our species are usually two- or three-carpellate. Occasionally 4 or 5 carpels may develop. These are exceptional, however, and are found only among the TRIVALVAE and not among the BIVALVAE. At anthesis the ovaries are usually ovoid or obovoid and measure from 3 to 7 mm. long, including the stipe when present. The latter varies from 0 to 2 mm. long.

In over 85 per cent of our species the ovaries are hairy in various degrees. Species with glabrous ovary, *P. glabratum*, *P. rehderianum*, *P. pentandrum*, *P. formosanum*, *P. humile*, and *P. heterophyllum* var. *sessile*, are easily recognizable and are constant in this feature.

The colour of the trichomes on ovaries is either brown or whitish, rarely rusty brown. Shape and size of the ovary do not render any help in the characterization of the species. The colour of the young ovaries in the herbarium is not constant; most of them are light brown, but in *P. formosanum* the ovary is glabrous and dries black; in *P. glabratum* it is glabrous and dries light brown. The style is uniformly glabrous in all our species.

The young ovary has as many locules as there are carpels, or it is semi-unilocular or unilocular. The mature capsules, however, are always unilocular. The fresh young ovary in cross-section has been diagrammed many times, showing axile placentae. In the description of the herbarium specimens the placentation is given as parietal. This is not contradictory. In the young ovary the placental ridges converge and meet along their whole length or only below the middle. Thus in the very young stage the ovary may appear to have as many locules as there are carpels, and the juxtaposed placentae appear axile. In an incompletely unilocular ovary only the basal cross-section of the young ovary shows the axile placenta. But in any case, as the ovary begins to mature and enlarge, the placental ridges retreat. In the incompletely unilocular ovary the aperture between placental ridges widens from top to bottom as the seeds develop. The mature capsules are always unilocular with parietal placentation.

Capsules: The capsules in all our species have a relatively smooth outer surface. They vary considerably in shape and size. In general, members in TRIVALVAE bear large capsules which are longer than broad, or when globular are over 1 cm. in diameter. The largest are in *P. ligni-*

bum, often measuring 3 cm. long and 2 cm. thick. The smallest are in *oligocarpum*, less than 1 cm. long. In shape they vary from ellipsoidal to obovoid or pear-shaped or globular. In cross-section they may be distinctly circular or somewhat 3-angled. In *P. glabratum* and *P. podocarpum* they are usually pear-shaped. In *P. trigonocarpum* and *P. sahnianum* they are ellipsoidal and angulate. In *P. boninense*, *P. chichijimense*, and *P. parvifolium* they are globular. In *P. tobira*, *P. makinoi*, and *P. luteum* they are globular and angulate.

Among the BIVALVAE most of the species bear capsules about the size of pea. Such small capsules are produced abundantly in *P. floribundum*, *P. napaulense*, *P. kerrii*, *P. formosanum*, *P. johnstonianum*, *P. daphniphyllodes*, and scantily in *P. heterophyllum*, *P. tetraspermum*, and *P. truncatum*.

About 25 per cent of the species in BIVALVAE bear large capsules, which are longer than broad. They may be laterally compressed and accordingly either quadrangular or circular in cross-section. In *P. confertum*, *P. baileianum*, and *P. balansae* the compressed fruits may have an undulate outline due to contractions between the seeds. The distinctly cylindrical capsule is produced by *P. henryi*.

Valves: The fruits being loculicidal, morphologically the valves are composed of halves of adjacent carpels. As a result the parietal placenta occupies the mid-line on the concave inner face of each valve. Externally the valves are convex and homogenous. There is no median vein or depression to suggest its dual nature.

In lateral outline the open valves vary from obovate-oblong to oblong and elliptic or almost circular. With the globular capsule most abundant in our species, the circular valve is the most common with us.

The dry valves in most species have numerous striations diverging from either side of the placenta in a pinnate arrangement. Such striations are usually lacking in *P. glabratum* and *P. chatterjeeanum*. A lack of striation appears to be correlated with a yellowish colour and a lack of surface secretion. In most of our species the striate inner face of the valve dries brownish and is coated with a somewhat lustrous resinous secretion.

The valves differ somewhat in their thickness. They vary from less than 1 mm. to as much as 4 mm. in thickness. All members of the tobira-complex have woody valves about 4 mm. thick. *Pittosporum glabratum* and *P. podocarpum* generally have somewhat coriaceous valves. The other members of the glabratum-complex have them usually woody.

Seeds: The seeds vary greatly in number, size, and shape. The number varies from many (i.e., 16 or more) to as few as four in each capsule. Four seeds per capsule is constant with some species such as *P. tetraspermum*, *P. floribundum*, *P. kerrii*, and *P. napaulense* var. *rawaldianense*.

In size the seeds vary from 2 mm. to 7 mm. in length; in shape they are roundish or reniform to irregular; and in colour usually red or dark

red. Such species as *P. glabratum* and *P. podocarpum* in the TRIVALVAE, and most of the balansae-complex in the BIVALVAE have roundish (7×5 mm.) red seeds. The tobira-complex has mostly reniform (7 mm. long) darkish red seeds. Four-seeded species in the BIVALVAE have somewhat reniform darkish red seeds. In the remaining species the seeds are usually small and irregular and generally similar.

The seeds are coated with a glutinous or resinous substance in all of the species. It is from this character that the genus derives its name. In *P. merrillianum* the seeds have an ariloid covering which forms a dry reddish coat over blackish red seeds. In most of the open capsules on the herbarium specimens the exposed seeds appear dry. Capsules opened afresh, however, show oily or resinous-coated seeds.

Seedlings: Germination of *Pittosporum tobira* (Japan, Ligetaka, Suzuki 391.052 was studied; (seeds, 7 mm. long, 3 mm. wide, covered with glutinous substance; indiscernible minute embryo imbedded in the horny endosperm close to the hilum, on the concave face of the reniform seed). Germination was very slow, and from sowing to full expansion of the cotyledons it took over three months.

The radicle emerged first, breaking through the seed coat. The hypocotyl became 3–4 cm. long, carrying the cotyledons and testa above the soil. The cotyledons eventually freed themselves, dropping the testa. At first the epicotyl was extremely small. The first pair of leaves was developed very slowly. Though the internode is indistinct, the differential development of the leaves suggests the alternate nature of the phyllotaxy.

The radicle is very slender and grows longer than the hypocotyl; it measured over 6–8 cm. in length when the hypocotyl was about 4 cm. long. It developed very few lateral roots. The viability of the seed was good.

The cotyledons were epigeous, two in number, almost sessile. On full development they were 2 cm. long and 1.5 cm. wide and oblongish ovate and obtuse. They were shining dark green and bore silvery white hairs along the veins.

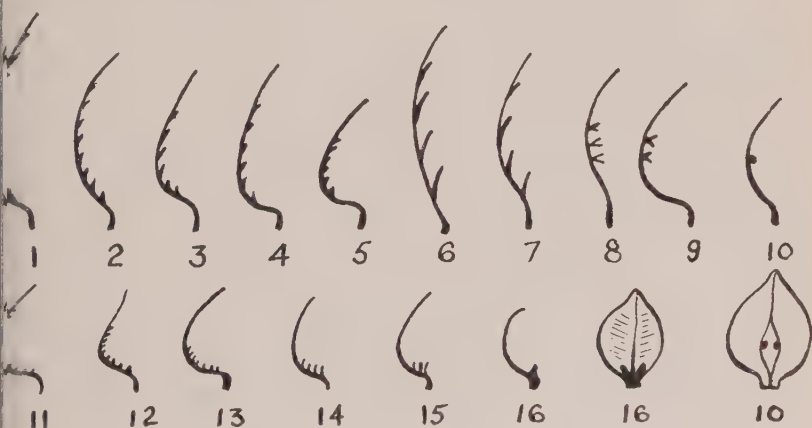
According to Lubbock, Seedlings 1: 200–204 (1892), *P. phillyraeoides* has 2 cotyledons, lanceolate and acute; *P. parvifolium* has 2 or 3 cotyledons, lanceolate and obtuse; *P. crassifolium* has 2 or 3 oblanceolate obtuse cotyledons; *P. erioloma* has 5 cotyledons which are in a whorl, lanceolate and subacute.

Placenta and funicles: The placenta occupies the mid-line on the inner face of each valve. Its fertile portion is usually elevated to form a placental ridge. This ridge varies greatly in length as well as in position. It may be developed along the whole length of the placenta or be restricted to its middle or base. It fails to be prominent and well marked only in a few species.

The funicles are either ribbon- or peg-like. They are borne along the placental ridge in two close parallel ranks (i.e., biseriate); and are so distributed as to appear either oppositely or alternately arranged along the ridge.

The funicles in *P. lignilobum* among the TRIVALVAE are many, biseriate, and borne along the whole length of the placenta. In *P. glabratum* and *podocarpum* they are few (8-4) on each ridge and alternate along the whole length of the placenta. In *P. trigonocarpum* and *P. sahnianum* they are biseriate, 6-8 in number and distributed along the middle sector of the placenta. The basal and apical portion of the placenta is infertile. *Pittosporum kobuskianum* develops only 4 funicles on each placenta. They are arranged in pairs at the middle.

The distribution of funicles in the large-capsuled species in the BIVALVAE shows variations similar to those in the TRIVALVAE. In *P. gagnepainianum* the funicles are many and biseriate. In *P. balansae*, *P. confertum*, *P. baileyianum*, and *P. chatterjeeanum* there are usually only four funicles on each valve. These alternate all along the placenta. In *P. henryi* there are 8 funicles on each valve, and these are restricted to the middle. In *P. merrillianum* there are only two funicles, and these are located at the middle of each placenta.



TEXT-FIGURE 3. Funicular distribution on placentae: FIGS. 1-10. TRIVALVAE and large-capsuled BIVALVAE. FIGS. 11-16. Small-capsuled BIVALVAE.

FIG. 1. *Pittosporum lignilobum*. FIGS. 2, 3. Tobira-complex. FIG. 4. *P. trigonocarpum*. FIG. 5. *P. sahnianum*. FIG. 6. *P. glabratum*. FIG. 7. *P. baileyianum*, *P. confertum*. FIG. 8. *P. henryi*. FIG. 9. *P. kobuskianum*. FIG. 10. *P. merrillianum*. FIGS. 11, 12. Undulatum-complex. FIG. 13. *P. anstonianum*. FIG. 14. *P. formosanum*. FIG. 15. *P. napaulense*. FIG. 16. *P. tetraspermum*, *P. kerrii*, *P. floribundum*.

The distribution of funicles in the small-capsuled species of BIVALVAE show quite a different pattern. *Pittosporum truncatum*, *P. eriocarpum*, *undulatum*, *P. ceylanicum*, *P. ovoideum*, and *P. dasycaulon* all have small and many funicles on each placenta. Only the apex of the placenta is infertile. In *P. napaulense*, *P. formosanum*, and *P. saxicola* there is a definite number of funicles and they are borne along the basal and supra-

basal part of the placental ridge. From the middle and towards the apex the placenta is infertile. In *P. floribundum*, *P. kerrii*, and *P. tetraspermum* there are only two funicles at the base of each valve. The whole length of the placenta on the valve is infertile.

It is evident from the foregoing that the number of funicles on a placenta varies from numerous to 8, 6, 4, or 2 on each valve. In turn these have a definite position on the placenta. These characteristic numbers, combined with their positions on the placenta, offer interesting characters in the classification of our species.

Distribution and interspecific relations: The species treated here cover the countries from the Bonin Islands, Japan, and the islands of Ryu-Kyu and Formosa to China, Indo-China, Siam, Burma, and India. China has the greatest concentration of species in the Asiatic regions, and there the genus makes its most northerly incursion into this hemisphere. In Asia the northern limit of the genus extends from southern Japan and Korea to Kiangsu in China, thence westward into the Yangtze drainage to eastern Sikang, and thence through Yunnan to the Indian outer Himalayas as far as Rawalpindi.

The islands of Bonin have four endemics, *P. boninense*, *P. chichijimense*, *P. parvifolium*, and *P. bicarpellatum*, as well as an endemic variety of *P. tobira*. The relationships of these plants are with species of Japan on the one hand and with those of the Ryu-Kyu and Formosa on the other. They have no close allies among the Indian *Pittospora*. *Pittosporum tobira*, most common in Japan, occurs also in the coastal provinces of China. It has close relatives on the islands of Ryu-Kyu and Formosa, but none in India. *Pittosporum tobira* var. *macrophylla* and *P. illicioides* are apparently endemic to Japan. The only *Pittosporum* in Korea is *P. tobira*. In the Ryu-Kyu Islands *P. lutchuense* is the only member of the genus. Though endemic, it closely resembles species of both Japan and Formosa. On the whole, members of the genus in the Ryu-Kyu and Bonin Islands have more resemblance to those of Japan than to those of China. Their relationship with the species of China seems to be through those of Formosa.

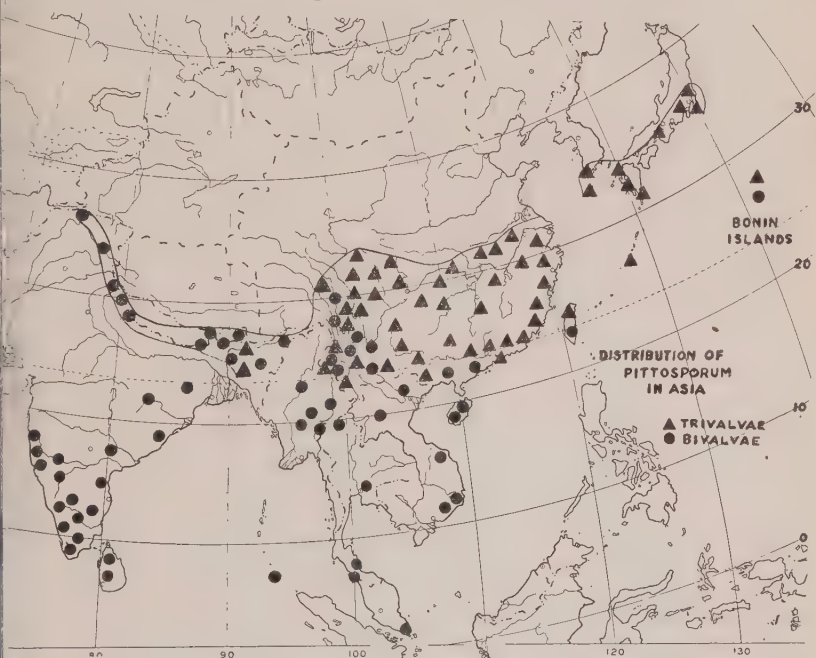
There are five species known from Formosa. *Pittosporum viburnifolium* is endemic to the island; *P. makinoi*, another endemic, very closely resembles *P. tobira*; *P. oligocarpum* occurs in China as well as in Formosa; *P. formosanum* and *P. daphniphylloides* both have their closest allies in China.

Over 60 per cent of the Asiatic *Pittospora* occur in continental China, in the Yangtze drainage and south of it. All the 14 species of the glabratum-complex except one (*P. podocarpum*) are confined there. The range of the individual species varies from local to widespread. *Pittosporum lignilobum* is localized in its distribution and occurs about Mt. Omei in Szechwan. *Pittosporum rehderianum* is known only from western Hupeh. *Pittosporum sahnianum* and *P. trigonocarpum* are widespread within China, while *P. podocarpum* extends from China to Assam in

India. The members of the BIVALVAE are concentrated in the western and southwestern parts of China. Some of the species found in Yunnan occur also in Assam, Burma, and Siam. For instance, *P. kerrii*, a species originally described from Siam, is very common in Yunnan, Burma, and Assam. The members of the balansae-complex, confined to Kwangsi and southwestern Kwangtung in China, occur in Hainan, Annam, Tonkin, and Upper Burma.

The distribution of the genus in India is restricted to two separate hill areas. One is the Himalayas, from Assam through Bhotan, Sikkim and Nepal Garwhal to Rawalpindi in northwestern Punjab; and the other the hills of the peninsula.

Pittosporum eriocarpum is endemic to western outer Himalaya and occurs up to 2200 m. altitude. The variety *P. napaulense* var. *rawalpindiense* is found as far as northwestern Punjab. *Pittosporum humile* is endemic to Assam. The species from Assam, in general, either occur also in the adjoining areas in Burma, Siam, and Yunnan or have the greatest resemblance to the species of these territories.



TEXT-FIGURE 4. Geographical distribution of the two major groups BIVALVAE and TRIVALVAE in Asia.

Five species are found in peninsular India. Of these only *P. dasycaulon* is endemic. It is confined to the Western Ghat-forests. *Pittosporum tribundum*, besides being common in South India, also occurs in Madagascar. *Pittosporum tetraspermum* occurs not only in South India and

Ceylon, but also from southwestern China. *Pittosporum ceylanicum*, once considered as endemic to Ceylon, occurs also in the Nilgiri Hills.

In summarizing the distribution of the genus in Asia, the following are interesting points:

1. The glabratum-complex and the tobira-complex of the TRIVALVAE are known only from the mainland of China, Formosa, the Ryu-Kyu and Bonin Islands, Japan, and South Korea. Only one of their members (*P. podocarpum*) extends into the Upper Burma-Assam territory from Yunnan. Isolated members of the TRIVALVAE occur in New Guinea, but they are not closely related to any of the Asiatic TRIVALVAE. Curiously, no species of TRIVALVAE seem to occur anywhere in the Philippines, Indonesia, Malaya, Indo-China, Siam, Lower Burma, South India, or Africa.

2. The members of the BIVALVAE not only range more widely in Asia than do the members of the TRIVALVAE, but also have more affinities outside the area. Most of the Asiatic species with bivalved small capsules have evident relation with the African species and with those of Malaysia. The close relationship between *P. kerrii* (Siam, China), *P. floribundum* (S. India, Madagascar) and *P. ripicola* (Central and East Africa) is especially noteworthy.

GROUPING

Putterlick, Synop. Pitt. 6-18 (1839), divided the genus into three subgenera, basing them on the kind and position of the inflorescences and the shape of the capsules. As has been mentioned, the inflorescences are very plastic, and no one kind is constant for any group of species in the genus, and this also is the case with regard to the shape of the capsules.

Carpel number, however, supplies a means of dividing the genus into two natural major groups. The species having two carpels are evidently a natural assemblage. They make up over 60 per cent of the representation of the genus in our area. Their carpel number is very constant. The other species usually have three carpels, but in some, occasional fruits on a plant may be aberrant in having only two or even as many as four or five carpels. Though not absolutely constant, three carpels is the prevailing and obviously basic number in this latter group. The name TRIVALVAE applied to it is appropriate. For the other group, species with only bicarpellate fruit, the name BIVALVAE is used. These may hold good for members of the genus in other areas also. Each group is further divided into species-complexes in our area.

KEY TO THE GROUPS AND SPECIES-COMPLEXES

- a. Capsules usually 3-valved, occasional fruits rarely 4- or 5- or 2-valved. Group I. TRIVALVAE!
- b. Leaf-apex acute or acuminate; ovary glabrous or hairy; capsules mostly pyriform, or cylindrical, or ellipsoid, longer than broad (globular or subglobular in nos. 5 and 10); valves coriaceous, thin or woody; funicles long, slender, and flat, or short and peg-like. Confined to China except nos. 3, 12, and 13. . . A. Glabratum-complex.

- bb. Leaf-apex obtuse or abruptly rounded, sometimes emarginate; ovary hairy; capsules globose or subglobose, rounded or angulate; valves woody; funicles short, peg-like. Korea, Japan, and Bonin Islands to Formosa and Coastal China,B. Tobira-complex.
- aa. Capsules 2-valved,Group II. BIVALVAE.
 - b. Capsules longer than broad, square or roundish in cross-section; seeds usually large, 5-6 mm. in diameter, roundish,C. Balansae-complex.
 - bb. Capsules usually as long as broad, subglobose or roundish, 6-12 mm. in diameter; seeds small, usually irregular or somewhat reniform.
 - c. Valves woody; capsules usually large, 10-12 mm. in diameter; sepals usually 3-9 mm. long, acute to acuminate; flower-buds often ovate; ovary hairy,D. Undulatum-complex.
 - cc. Valves thin; capsules usually small, 6-10 mm. in diameter; sepals usually 1-4 mm. long, rounded, obtuse or acute; flower-buds oblong; ovary glabrous or hairy,E. Floribundum-complex.

KEY TO THE SPECIES

GROUP I. TRIVALVAE

A. *Glabratum*-complex:

- a. Capsules broadest at or above middle, obovoid or pyriform or cylindric; stipe usually tapering, 0-5 mm. long; valves coriaceous or thin, creamy yellow inside; funicles slender, flat, 3-5 mm. long, yellowish, usually not imbedded in gummy secretion; seeds large, usually 5-8 mm. long, roundish or somewhat reniform, usually red to pink.
 - b. Leaves less than three times as long as broad, roundish obovate or broadly oblong,1. *P. perryanum*.
 - bb. Leaves over three times as long as broad.
 - c. Ovary glabrous,2. *P. glabratum*.
 - cc. Ovary hairy.
 - d. Funicles more than 3 on each placenta; seeds more than 8-12; leaves large, over 6-8 cm. long; capsules large, usually pear-shaped,3. *P. podocarpum*.
 - dd. Funicles only 2-3 on the middle section of each placenta; seeds less than 8; leaves small, 2-4 cm. long; capsules small, cylindrical,4. *P. kweichowense*.
- aa. Capsules broadest at the middle, angular-ellipsoid, or globular; stipe absent or usually abruptly constricted; valves woody or thin, brown inside; funicles usually short, peg-like, darkish red, usually imbedded in the whitish gummy secretions; seeds small, irregular, darkish red.
 - b. Ovary glabrous; sepals slightly connate at base, glabrous, membranous, 1-2 mm. long, obtuse; petals 10-12 mm. long,5. *P. rehderianum*.
 - bb. Ovary hairy.
 - c. Valves woody, up to 4 mm. thick; capsules large, 10-30 mm. long.
 - d. Sepals short, 2-3 mm. long, oblong-ovate, obtuse or rounded; capsules ellipsoidal.

- e. Petals 9–11 mm. long; ovary 5 mm. long; capsules usually 15–20 mm. long; valves 3..6. *P. trigonocarpum*.
- ee. Petals 12–14 mm. long; ovary 7 mm. long; capsules over 20 mm. long, often 35 mm. long; valves 3–5....
.....7. *P. lignilobum*.
- dd. Sepals 7 mm. long, narrowly lanceolate, acuminate; capsules ovoid.....8. *P. subulisepalum*.
- cc. Valves usually thin, up to 1 mm. thick; capsules 6–20 mm. long (capsules not seen in No. 9).
 - d. Petals 12–15 mm. long; pedicels usually equal to or slightly longer than the petioles.....9. *P. crispulum*.
 - dd. Petals less than 10 mm. long; pedicels longer than petioles.
 - e. Funicles 4 on each valve, slender, flat, in pairs on the middle section of the placenta..10. *P. kobuskianum*.
 - ee. Funicles more than 4 on each valve, short and peg-like, distributed along the placenta except at base and apex.
 - f. Pedicels long and slender, over 20–40 mm. long; fruits often pendulous.
 - g. Capsules extremely small (smallest in TRI-VALVAE in Asiatic species), 6 mm. long, without abruptly constricted stipe; inflorescence a simple cyme; flowers small, petals usually 6–7 mm. long; pedicels extremely slender, less than 1 mm. thick.....
.....11. *P. oligocarpum*.
 - gg. Capsules large, 10 mm. long; stipe abruptly constricted; inflorescence a cluster of single flowers; flowers large, petals usually 8 mm. long; pedicels more than 1 mm. thick.....
.....12. *P. sahnianum*.
 - ff. Pedicels short, 10–12 mm. long; fruit usually erect.
 - g. Sepals connate at base, obtuse, 2–3 mm. long, unequal, ciliate; petals yellow. Japan.....
.....13. *P. illicioides*.
 - gg. Sepals free, acuminate or acute, narrow-lanceolate, 4–5 mm. long, equal, non-ciliate; petals white. China....14. *P. pauciflorum*.

B. Tobira-complex:

- a. Valves usually 1–2 mm. thick; capsules angulate; flowers usually less than 10 mm. long (or in No. 15, sometimes as long as 13 mm.).
 - b. Inflorescences composed of cymose clusters; capsules large, over 10 mm. long.
 - c. Inflorescences very conspicuously tomentose; leaves obovate, broadest above middle and abruptly rounded at apex, frequently emarginate. Japan, Korea, China.....15. *P. tobira*.
 - cc. Inflorescences inconspicuously pilose; leaves obovate or obovate-elliptic, broadest at or above the middle, obtuse or rounded at apex. Formosa and Ryu-Kyu.

- d. Petals 8–10 mm. long; sepals ovate, acute, equal and symmetrical; leaves usually obovate, broadest above middle, usually rounded at apex. Formosa.....16. *P. makinoi*.
- dd. Petals 7–8 mm. long; sepals unequal, irregular in outline; leaves obovate-elliptic, broadest at or slightly above middle, obtuse at apex. Ryu-Kyu.....17. *P. lutchuense*.
- bb. Inflorescences umbellate, glabrous, capsules 9 mm. in diameter. Fukiên.....15B. *P. tobira* var. *fukiênense*.
- aa. Valves 3–4 mm. thick; capsules usually rounded (not seen in No. 15C); flowers usually large and over 10 mm. long (in No. 15C only 10 mm. long). Bonin Islands.
 - b. Flowers umbellate or solitary.....18. *P. parvifolium*.
 - bb. Flowers in cymose clusters.
 - c. Peduncles and pedicels glabrous; flowers 10 mm. long; leaves obovate-elliptic, obtuse at apex....15C. *P. tobira* var. *sakuraii*.
 - cc. Peduncles and pedicels usually pubescent; flowers over 10 mm. long; leaves obovate, rounded at apex.
 - d. Peduncles 20–35 mm. long; pedicels 5–20 mm. long.....19. *P. boninense*.
 - dd. Peduncles short, 10–25 mm. long; pedicels 40–60 mm. long.....20. *P. chichijimense*.

GROUP II. BIVALVAE

C. Balansae-complex:

- aa. Large capsules, usually 2 cm. or more long, generally compressed, more or less square in cross-section.
 - b. Seeds 8 or fewer; flower-buds usually ovate; leaf-apex acute to acuminate; capsules often undulate due to depression between seeds; inflorescences densely tomentose with brown hairs; flowers sessile or short-pedicelled.
 - c. Leaves narrow-lanceolate, over four times as long as broad; flowers usually pedicellate.....21. *P. baileyianum*.
 - cc. Leaves elliptic or oblong, broader at or above middle, two or three times as long as broad; flowers sessile or short-pedicelled.
 - d. Leaves usually oblong to elliptic-oblong, broader just above middle, usually glabrous; sepals oblongish lanceolate, acute, 4 mm. long; flowers usually sessile and in fascicles; hairs silky, bright brown.....22. *P. confertum*.
 - dd. Leaves usually elliptic, broadest at middle, both ends acute, usually pubescent along the veins; sepals narrow-lanceolate, acuminate, 5–6 mm. long; flowers usually short-pedicellate; hairs blackish brown; sometimes leaf-apex acuminate....23. *P. balansae*.
 - bb. Seeds more than 8; leaf-apex rounded or long-acuminate.
 - c. Funicles short, peg-like, 1 mm. long, distributed in pairs from base to or beyond middle of the placenta; valves thick, reddish brown outside, pale brown inside; leaf-apex obtuse or rounded. Indo-China.....24. *P. gagnepainianum*.

- cc. Funicles slender, flat, 2-3 mm. long, alternate along the whole length of the placenta; valves thin, yellowish outside, yellowish white inside; leaf-apex long-acuminate. Burma.....25. *P. chatterjeeanum*.
- aa. Medium capsules, usually 10-15 mm. long, cylindrical or ellipsoidal, more or less circular in cross-section.
 - b. Funicles slender, flat, creamy yellow, 1-2 mm. long, 6-8 on each valve, distributed in pairs along the middle section of the placenta; capsules cylindrical, 14-15 mm. long. China.....26. *P. henryi*.
 - bb. Funicles knob-like, dark brown, short, 2 on each valve; capsules ellipsoidal 10-12 mm. long. Indo-China.
 - c. Leaves less than three times as long as broad, broadly elliptic, both ends acute; petioles short, 10 mm. long.....27. *P. merrillianum*.
 - cc. Leaves more than three times as long as broad, oblong or elliptic-oblong, petioles long, 15-25 mm. long.....27A. *P. merrillianum* var. *poilanei*.

D. Undulatum-complex:

- a. Calyx 4-9 mm. long, sepals (or lobes) acuminate; flower-buds ovate except in No. 31.
 - b. Calyx densely tomentose.
 - c. Calyx up to 9 mm. long, united to form a long tube, the tube split into two parts, one 2-lobed, the other 3-lobed.....28. *P. undulatum*.
 - cc. Calyx up to 4 mm. long, sepals free, narrow-lanceolate.....29. *P. ferrugineum*.
 - bb. Calyx usually glabrous.
 - c. Sepals free, 4-5 mm. long. China.....30. *P. ovoideum*.
 - cc. Sepals connate at base, 7 mm. long. Bonin Islands.....31. *P. bicarpellatum*.
- aa. Calyx usually less than 4 mm. long, sepals obtuse or acute; flower-buds oblong except in No. 36.
 - b. Leaf-apex obtuse or rounded.
 - c. Peduncles much shorter than leaves; petals large, 10-12 mm. long; inflorescence brown-tomentose. Formosa.....32. *P. viburnifolium*.
 - cc. Peduncles equal to or longer than leaves; petals smaller, 8 mm. long; inflorescence glabrous. Ceylon and South India.....33. *P. ceylanicum*.
 - bb. Leaf-apex acute to acuminate.
 - c. Leaves and young branches densely brown-tomentose; inflorescence densely brown-tomentose, flower-buds oblong.
 - d. Leaves elliptic, broader at middle; adult leaves usually glabrous; South India.....34. *P. dasycaulon*.
 - dd. Leaves usually broadly oblong, or elliptic-oblong, broader above middle; adult leaves tomentose on both the surfaces. Western Himalayas.....35. *P. eriocarpum*.
 - cc. Leaves and young branches glabrous; inflorescence usually glabrous; flower-buds ovate. South India..36. *P. neelgherrense*.

E. Floribundum-complex:

- a. Ovary glabrous.
 - b. Calyx cup-like, lobes very short and obtuse; inflorescences supra-axillary.....37. *P. nervosum*.
 - bb. Calyx with sepals longer and free or only slightly connate at base, obtuse or acute; inflorescences terminal or axillary.
 - c. Leaves broadly ovate to obovate. Formosa.....38. *P. formosanum*.
 - cc. Leaves narrowly lanceolate. Assam.....39. *P. humile*.
- aa. Ovary pubescent.
 - b. Inflorescences profusely branched, terminal or pseudoterminal; leaves usually large, oblong, or obovate, or obovate-oblong.
 - c. Inflorescences not compound umbellate.
 - d. Inflorescences usually paniculate, not pyramidal, pubescent with whitish hairs.
 - e. Seeds more than 4 per capsule; funicles basal to supra-basal. China and outer Himalayas.
 - f. Petals 6-8 mm. long; leaves usually 4-12 cm. long, obovate, seeds 10 or more per capsule. China.....40. *P. brevicalyx*.
 - ff. Petals 5-6 mm. long; leaves usually long, oblong or oblanceolate-oblong; seeds 4-8 per capsule. Outer Himalayas, North India.....41. *P. napaulense*.
 - ee. Seeds usually 4 per capsule; funicles distinctly basal; leaves usually small, 6-12 cm. long, 2-4 cm. wide, often undulate towards margin. South India and Madagascar.....42. *P. floribundum*.
 - dd. Inflorescences usually compound-corymbose, pyramidal; pubescent with brown hairs.
 - e. Seeds 4 per capsule; funicles basal; sepals ovate, obtuse, membranous, ciliate. Siam, Burma, Assam and Southwest China.....43. *P. kerrii*.
 - ee. Seeds 8-16 per capsule; funicles basal to infra-medial; sepals oblong, rounded at apex, non-membranous, non-ciliate.....38. *P. formosanum*.
 - cc. Inflorescences usually compound-umbellate.
 - d. Peduncles 20-30 mm. long; inflorescence loose; leaf-apex usually long-acuminate; leaves relatively small and narrow, 8-15 cm. long, 2-5 cm. wide, lanceolate or elliptic-lanceolate.....44. *P. johnstonianum*.
 - dd. Peduncles 5-15 mm. long; inflorescence compact; leaf-apex acute; leaves usually large and broad, 10-35 cm. long, 5-8 cm. wide, broadly elliptic.
 - e. Leaves large, often 35 cm. long (usually 15-19 cm. long); petioles stout and long, 2-4 cm. long. China...45. *P. adaphniphylloides*.
 - ee. Leaves relatively smaller, usually 10-16 cm. long; petioles short, 1-2 cm. long. Formosa.....46. *P. daphniphylloides*.

- bb. Inflorescences simply umbellate, or subumbellate or single-flowered, pseudoterminal (in No. 51 corymbose-like and terminal); leaves ovate or narrow-lanceolate.
 - c. Leaves obovate, elliptic or elliptic-ovate.
 - d. Seeds only 4 per capsule; funicles basal; leaves elliptic to obovate. South India, Indo-China and China.....47. *P. tetraspermum*.
 - dd. Seeds more than 4 per capsule; funicles distributed from base to middle of the placenta.
 - e. Sepals 4-5 mm. long; inflorescences few-flowered or single-flowered; leaves elliptic, acuminate.....48. *P. leptosepalum*.
 - ee. Sepals less than 4 mm. long; inflorescences many-flowered; leaves obovate, abruptly acute.....49. *P. truncatum*.
 - cc. Leaves narrow-lanceolate.
 - d. Leaves 10-19 cm. long, strap-shaped or narrow-lanceolate, apex acuminate or acute, but not apiculate; petals 14 mm. long. Indo-China.....50. *P. oblongilimbum*.
 - dd. Leaves less than 10 cm. long, extremely narrow, heteromorphous, apex apiculate; petals less than 11 mm. long.
 - e. Inflorescences usually corymbose, terminal; seeds 10-14. Indo-China.....51. *P. pulchrum*.
 - ee. Inflorescences umbellate, or subumbellate or single-flowered. China.
 - f. Leaves of two types on the plant, narrow-lanceolate to oblanceolate, and obovate; seeds 5-8.....52. *P. heterophyllum*.
 - ff. Leaves extremely small and narrow, 20-35 mm. long, 3-9 mm. wide; subsessile..53. *P. saxicola*.

1. *Pittosporum perryanum* sp. nov.

Frutex 1 m. altus; foliis obovatis vel obovato-oblongis 8-17 cm. longis 4-6 cm. latis firmiter coriaceis glabris, apice plus minusve abrupte acutis, subtus areolis conspicuis laxis angulatis evidenter donatis; petiolo brunneo 5-15 mm. longo; floribus ignotis; capsula solitaria subcylindrica 18-25 mm. longa 12-15 mm. crassa, crasse 10-14 mm. longe pedicellata; valvis 3 firme coriaceis in ambitu late oblongis; funiculis 2-3 mm. longis gracilibus compressis placenta, usque ad 5-6 mm. supra basim sterili alibi fertili; seminibus 12 vel plus, 6-7 mm. longis, rubris.

Broad-leaved shrub, 1 m. tall; branching verticillate or forking; bark greyish brown; lenticels inconspicuous; leaves loosely crowded at forking and towards the ends of branches, blades roundish obovate to obovate-oblong, firmly coriaceous, glabrous, 8-17 cm. long, 5-6 cm. wide, veins on lower face prolonging to form submarginal vein, areolae conspicuous, large, polyhedral, clearly visible on the lower face, apex somewhat abruptly acute, margin entire, slightly recurved, petioles dark brown 5-15 mm. long; flowers not seen; capsules somewhat cylindrical, green or brown, 18-25 mm. long, 12-15 mm. thick, 3-valved, borne singly on a short

stout fruit-stalk 10–14 mm. long; valves thin, less than 1 mm. thick, firmly coriaceous, broadly oblong in outline, inside creamy or brownish; funicles 2–3 mm. long, alternate or in pairs, distributed from 5–6 mm. above the base of the placenta, the base 5–6 mm. long, infertile; seeds over 12 per capsule, large, 6–7 mm. long, red.

Known from West Kwangtung, Kwangsi and Yunnan.

KWANGTUNG: Sup Man Ta Shan, *Liang* 69823 (TYPE, A).

KWANGSI: Tsin Hung Shan, N. Hin Yen, alt. 1500 m., *Ching* 7005 (A).

YUNNAN: s. l., *Wang & Liu* 85091 (A).

Pittosporum perryanum is closely allied to *P. glabratum* and *P. podocarpum*, but differs from them in the shape and size of its leaves and capsules. Moreover, the areolae on the lower face of the leaves are readily visible to the naked eye, and they are large as compared to those of the other members of TRIVALVAE.

It is a pleasure to associate the name of this species with that of Dr. Lily M. Perry, in recognition of her work on the genus.

2. *Pittosporum glabratum* Lindley, Jour. Hort. Soc. London 1: 230 (1846). — Based on a plant collected by Fortune at Hongkong, and cultivated in the Horticultural Society Garden, London, England.

Pittosporum Fortunei Turcz., Bull. Soc. Nat. Moscow 36: 562 (1863); Bretschneider, Hist. Europ. Bot. Disc. China 434 (1898). — Based on a collection by Fortune from Hongkong.

Shrubs 1–2 m. tall; bark grey or greyish green; young branches brownish and dotted with lenticels; reduced leaves bract-like on long shoots and pilose with brownish hairs; leaves crowded towards the ends of branches, petioles 5–10 mm. long, blades coriaceous, glabrous, deep green or lustrous green above, pale green below, broadly elliptic or oblanceolate, 4–12 cm. long, 1.5–4 cm. wide, apex acute to acuminate, margin entire, slightly recurved; inflorescences pseudoterminal, slightly pubescent, umbellate or single-flowered, bracteate at base; bracts and bractlets mostly pilose with brownish soft silky hairs, margin densely ciliate; pedicels pilose, bracteate at base; flowers fragrant, polygamo-dioecious, short-stamened flowers usually solitary, long-stamened flowers in umbel; sepals free or slightly connate at base, densely ciliate, oblong or ovate or lanceolate, 1–3 mm. long. Short-stamened flowers: flowers robust, 8–10 mm. long; sepals early deciduous; corolla large, 9–12 mm. long; stamens short, appressed to but not surpassing the body of the ovary, anthers poorly developed, abortive, sagittiform; ovary well developed, glabrous, obovoid or pyriform with base tapering into stipe; style short, stigma capitate, rarely 3-lobed. Long-stamened flowers: usually umbellate; pedicels 3–10 mm. long; flower-buds slender 6–9 mm. long; corolla 7–10 mm. long, often slightly united at base, lobes reflexed after opening; stamens well-developed and as long as the corolla tube, reaching stigma, and bearing full-sized oblong anthers; ovary glabrous, somewhat cylindrical, gradu-

ally tapering into style; style glabrous; stigma capitate. Capsules 2–2.5 cm. long, 3-valved, pyriform with tapering stipe, greenish yellow; stipe 3–5 mm. long; fruit-stalk 3–10 mm. long; valves coriaceous, inner surface creamy yellow; funicles slender, flat, 3–5 mm. long, alternate, distributed along the whole length of the placenta; seeds large, roundish, 7×5 mm., pink or red.

HONGKONG: Wong Nei Chong Gap, *Tsiang* 278 (A); Tseh Kou Yeu Shan, *Tsiang* 92 (A); Lu Kai Dau Peak, *Tsiang* 249 (A); Kwan Ying Temple, *Chun* 4789 (A); s. l., *Chun* 5189 (A); Castle Peak Monastery and vicinity, *Taam* 1132 (A); Shek-O, *Taam* 1901 (A); between Wanchai Gap and Wongneicheong Gap, March 28, 1919, *Swingle s. n.* (A); s. l., *Wright* 26 (GH); *Lamont* 28 (A).

KWANGTUNG: Kwai Shan, *Tsang* 28522, 28633 (A); Joi Pe Loh, Kau Lung Fung, *Tsang* 20011 (A); Tai Mo Shan, *Tsang* 21079 (A); Sam Kok Shan, *Tsang* 24852 (A); Tsing Wan Shan, *Lau* 2255 (A); Pan Ling Tsze, *Chun* 5878 (A); Ting Wu Shan, *Chun* 6471 (A); Canton, alt. 800 m., *Handel-Mazzetti* 653 (A); Ting Wu Shan, *Tsiang* 759, 797 (A); Kwang Tso Kong, *Tsiang* 176 (A); Lo Fou Shan, alt. 245 m., *Tsiang* 1726, 1736 (A); same locality, *Ford* 592 (A).

This plant is said to flower early in the spring and to bear pale greenish white and very sweet scented flowers.

In 1845, a living plant was sent from Hongkong by Fortune to the Royal Horticultural Society Garden, London. It was described by Lindley in 1846 as *P. glabratum*. His description was very meagre and incomplete, and the species has remained confused and poorly understood. Hooker, *Fl. Brit. India* 1: 198 (1872) identified it with Indian material. Later many more Chinese collections were assigned to the species. The distribution of *P. glabratum* was usually stated to cover the whole of China and North India.

What past botanists accepted as a single variable species is, in fact, a complex of species. In this paper it is treated as the glabratum-complex of TRIVALVAE. It includes, in addition to *P. glabratum*, about 14 species and two varieties. Typical *P. glabratum* is confined to Hongkong and Kwangtung and is readily distinguishable from other members of the complex by its completely glabrous ovary and pyriform capsule.

The flowers are markedly dimorphic. Normal hermaphrodite flowers, with slender cylindrical ovary and well-developed stamens, are borne usually in clusters. Their anthers reach the level of the stigma or project slightly beyond. The short-stamened flowers show marked structural differences. They are robust, usually solitary flowers with a plump fertile ovary, and bear only short stamens with abortive anthers.

The specimens with solitary short-stamened flowers may appear to be different from those with clustered long-stamened flowers, but the glabrous ovary, the obovoid or pyriform capsules, and the general appearance of the plant give safe guidance for the ready recognition of the species.

By restricting *P. glabratum* to Hongkong and Kwangtung plants, with

a glabrous ovary, *P. podocarpum* becomes a clear-cut species easily recognizable by its hairy ovary. Fortunately there appears to be no intergradation between these two species in this particular feature. For all practical purposes they are satisfactory species.

2A. *Pittosporum glabratum* var. *neriifolium* Rehder & Wilson, Pl. Wils. 3: 328 (1916).—Type: western Hupeh, Patung Hsien, Wilson 3181. Shrub 1–2 m. tall; leaves narrowly lanceolate, usually 10–15 (rarely 20) cm. long, 1–2.7 cm. wide, broader at or below the middle, glabrous, coriaceous; glabrous ovary.

Known from Western Hupeh and Szechwan, south to Hunan, Kiangsi, Kweichow and Kwangtung.

WESTERN HUPEH: Patung Hsien, alt. 1000 m., Wilson 361, 3181 (A); Chienshih Hsien, Chow 1187 (A); Kwan Ying Tong, alt. 1300 m., Chun 3664 (A); s. l., Henry 5422 (GH). •

SZECHWAN: Kuan Hsien, alt. 1000 m., Fan and others 58 (A).

KWEICHOW: Huang Chia Wan, alt. 1400 m., Steward, Chiao & Cheo 718 (A).

HUNAN: Ma Ling Tung, alt. 600 m., Li 486 (A); Yun Shan, Handel-Mazzetti 12150 (A).

KIANGSI: An Fu Woo, King Shan, alt. 1600 m., Hu 719 (A).

KWANGTUNG: Samkok Shan, Tsang 24944 (A).

HONGKONG: Hongkong woods, Tutcher 9501 (A).

This variety differs from the species only in the form and size of the leaves. The leaves are very narrowly lanceolate, usually over six times as long as broad. This form and size are constant in most specimens. There are, however, a few intergrading specimens which could be placed either in the species or in the variety.

3. *Pittosporum podocarpum* Gagnepain, Not. Syst. 8: 211 (1939).

Pittosporum glabratum sensu Hooker, Fl. Brit. Ind. 1: 198 (1872), as to plants of India.

Pittosporum glabratum var. *ciliicalyx* Franchet, Bull. Soc. Bot. France 33: 414 (1886).—Type: Yunnan, Tchen-Fong-Chan, Delavay 183.

Pittosporum glabratum var. *angustifolium* Pritzel in Diels, Bot. Jahrb. 29: 378 (1900), *nomen nudum*, Bock v. Rosthorn 3146 from "Tsou Ma Ling Kuan Hsien."

Pittosporum glabratum var. *chinense* Pampanini, Nuov. Giorn. Bot. Ital. n. ser. 17: 285 (1910).—"Types" Silvestri 873–876, from Hupeh.

Shrub 1–3 m. tall; branches forking or verticillate; leaves crowded at the forks and towards the ends of branches, petioles 5–15 mm. long, blades thin-coriaceous, glabrous, oblanceolate to elliptic, usually 6–13 cm. long, 2–3.5 cm. wide, rarely 14 cm. long, 4 cm. wide, apex acute to acuminate, margin entire, slightly recurved; inflorescences umbellate to subumbellate or single-flowered, glabrescent to densely hairy, pseudoterminal, or after the development of an adjacent shoot, apparently lateral; pedicels 10–15 (rarely –20) mm. long; bracts and bractlets glabrescent or densely hairy; flowers polygamo-dioecious, 8–15 mm. long; sepals free or slightly con-

nate at base, 1–3 mm. long, ovate or irregular, membranous, usually ciliate. Short-stamened flowers: usually solitary; petals 8–15 mm. long; filaments 3–6 mm. long; anthers sagittiform, usually shrivelled and poorly developed; ovary plump, well developed, densely covered with light brown hairs; style glabrous 3–4 mm. long; stigma more or less capitate; fruit as in long-stamened flower. Long-stamened flower: flowers usually umbellate to subumbellate; petals 8–12 mm. long; filaments 8–9 mm. long, anthers somewhat oblong, well developed; ovary cylindrical, densely covered with light brown hairs; style glabrous, 3–5 mm. long; stigma pointed. Capsules usually solitary or in clusters of 2 or 3, borne on fruit-stalk 8–20 mm. long, pyriform, 2–3 cm. long, 1–1.5 cm. thick, 3-valved; valves coriaceous, obovate in outline, inside creamy, usually wrinkled or striate; funicles slender, flat, 3–4 mm. long, alternate along the whole length of the placenta; seeds usually large, 7×5 mm., roundish, red.

An extremely variable species and very widely distributed, ranging from China and the hilly forests of Assam south into Burma and Indo-China. It is common in Yunnan and Szechwan.

SZETCHWAN: Mt. Omei, alt. 550–2500 m., *Yü* 190, 237, 446 (A); *Wilson* 583, 4744 (A); *Liu* 1468, 1721, 1824 (A); *Fan* 810 (A); *Yin* 237 (A); *Sun & Chang* 1255 (A); *Sung Pan Hsien, Fang* 6033 (A); Huayenting, alt. 1600 m., *Chow* 9766 (A); Chutien, alt. 1760 m., *Chow* 9941 (A); Kuan-hsin-po, alt. 1200 m., *Sun & Chang* 1458 (A); Tsuan-tien-po, alt. 2000 m., *Sun & Chang* 896 (A); Niu-hsin-ssu, alt. 850 m., *Tai* 463 (A); Wuan-hsin-po, alt. 1200 m., *Tai* 1055 (A).

HUPEH: Lungo, *Silvestri* 874–876 (A); N. Tan-sien, *Silvestri* 4131 (A); s. l., *Wilson* 657, 3414, 7850A (A, GH).

KWEICHOW: Liang Feng Yah, *Steward, Chiao & Cheo* 144 (A); Ta-chon, Tsingchen, *Teng* 90123 (A).

KWANGSI: Loh Hoh Tsuen, Ling Yün Hsien, alt. 1900 m., *Chao* 142 (A); Chen Pien, *Ko* 56102 (A); Ling Wan, *Lau* 28743 (A).

INDO-CHINA: Tonkin, *Poillane* 12815 (A).

YUNNAN: Mienning, Poshang, *Yü* 18057 (A); Yuanchey, alt. 1600 m., *Henry* 13403 (A); Mengtze, N. Mt., alt. 2000–3000 m., *Henry* 10191A, 10551, 10553 (A); Pin Tshouan, *Ducloux* 530, 6709 (A, NY); Lan Tsang Hsien, alt. 2200 m., *Wang* 76796 (A); Chui Pien Hsien, alt. 1300 m., *Tsai* 51404 (A); Ping Pien Hsien, alt. 1500 m., *Tsai* 62676 (A); Chen-hsuing Hsien, alt. 1200 m., *Tsai* 52228 (A); Kuyung, *Rock* 7552 (A); Che-Kio-Chan, alt. 2600 m., *Marie* 512 (A); around Pe Yen Tsin, *Ten* 603 (A); Tchen Fong Chan, *Delavay* 183 (A, phot.).

BURMA: Hills between Mong Kai and Mong Wa, *Ward* 8825 (A); Pumpri Bum, alt. 1800 m., *Wood s. n.* (C).

INDIA: Assam, Shillong, alt. 2000 m., *Ruse* 55 (A); Jowai Road, 1892, *Prain s. n.* (C); alt. 1300 m., *King s. n.* (C); Manipur, *Watt s. n.* (A, C); Chingson, alt. 2000 m., *Watt* 5908 (C); Khasia Hills; alt. 1000–1800 m., *Kurz* 215 (C), 391 (A, C); alt. 1600 m., *Clarke* 14860, 18723, 43639 (C); *Mann s. n.* (C); *Oldham* 8 (C); alt. 1300 m., *Hooker & Thomson s. n.* (C); *S & Kg* 734 (C). Naga Hills, Iapoo (C); Konoma, *Watt* 11531 (C); Mawphlang, *Carter* 1189, 1605 (C).

It is evident that Franchet's varietal name, Pampanini's varietal name, and Gagnepain's name were all proposed for one form or another of the same species. The authors were probably unaware of its dimorphic flowers and the variation in form of its inflorescence.

The following details concerning floral variation merit some discussion. The specimen *Yü 237* bears short-stamened flowers in umbellate cluster; *Yü 190* bears long-stamened flowers in umbellate cluster. The cluster and flowers in these two specimens are similar except for the slight differences in the ovary and in the length of the filaments. *Henry 10553* has long- and short-stamened flowers. The ones with short stamens are solitary and larger, whereas those with long stamens are in clusters and somewhat smaller. *Ducloux 6709* bears only short-stamened flowers, which are solitary and unusually large. These flowers are nearly twice as large as any long-stamened flowers observed in the species. Here the ovary is plump and well developed; the filaments are short and do not surpass the body of the ovary; the anthers are almost abortive. In fact, this species exhibits a gradual shortening of stamens from 8–9 mm. long to 3–4 mm. long and illustrates the accompanying correlations; the gradual reduction of anthers from a well developed to an almost abortive condition; the gradual transformation of hermaphrodite flower to functional unisexuality; and the reduction of many-flowered inflorescences to single-flowered ones.

In spite of such variations the species is distinctive in (a) its pubescent ovary, (b) its obovoid or pyriform capsule, (c) its coriaceous valve, (d) its long, slender, flat funicles, 3–4 mm. long, and (e) its large red seed.

It is very closely allied to *P. glabratum* and distinguished from the latter mainly by its pubescent ovary and by its geographical area.

33A. *Pittosporum podocarpum* var. *angustatum* var. nov.

Foliis anguste lanceolatis 8–16 cm. longis, 1–2 cm. latis; floribus polygamo-dioicis; ovario pubescente.

Leaves narrow-lanceolate, 8–16 cm. long, 1–2 cm. wide (occasionally 3 cm. wide at middle) broadest at the middle, glabrous, coriaceous; ovary pubescent.

This variety follows the range of the species in its distribution.

SZECHEWAN: Mt. Omei, alt. 1500 m., *Yü 450* (A), *Fang 3059* (A); Yalung, Yenyuen, alt. 2700 m., *Handel-Mazzetti 2613* (A); O-Pien Hsien, alt. 2200 m., *Yü 637* (A); Kuan Hsien, alt. 1000–1200 m., *Fang 2190* (A); Mt. No-Mi-San, 1899, *Hugh s. n.* (A); Ping-Shan Hsien, alt. 1800 m., *Wang 22751* (A); s. l., *Wilson 3231, 3231a* (A).

HUPEH: Ichang, alt. 1000 m., *Wilson 657* (A); s. l., *Henry 7850a* (A). KWANGSI: Chuen Yuen, alt. 1100 m., *Chung 83304* (A).

YUNNAN: Mengtze, N. mount. forests, alt. 7000 ft., *Henry 10545* (TYPE, A) (shrub, 5–6 ft., yellow flowers); same locality, alt. 5000 ft., *Henry 10191B* (A); Yuanchey, alt. 6000 ft., *Henry 13299* (A); Wen-Shan Hsien, alt. 1800 m., *Tsai 51717* (A); Chiu-Pei Hsien, alt. 1800 m., *Tsai 51415* (A); Ping-Pien Hsien, alt. 1500 m., *Tsai 61783, 62787* (A); s. l., *Tsai 52004, 55686, 56000* (A); Mienning, alt. 2350 m., *Yü 18081* (A); Tsang-Yuan, alt. 1500 m., *Wang 73279* (A).

BURMA: Myitkyina, Kangfang-Pawte Road, alt. 2000 m., *Kermode* 17290 (Dehra Dun Herb.) (shrub, 3 ft. high, flowers yellow, scented).

INDIA: Assam: Manipur, *Watt* 6538 (C); Japvo, *Watt* 11453 (C); Kohima, *Watt* 11612 (C); Kononur, alt. 1300 m., *King* 212 (C); Khasia Hills, Sibpur Bot. Gard. Herb. 34133 (C); Shillong Peak, alt. 2100 m., *Kanjilal* 2312 (C).

This variety differs from the species only in the form and size of its leaves. A parallel to this is found in *P. glabratum* and its variety.

4. *Pittosporum kweichowense* sp. nov.

Frutex; ramulis apicem versus pubescentibus; foliis 2–4 cm. longis 1–1.5 cm. latis, ellipticis vel elliptico-lanceolatis firmiter coriaceis glabris, apice acutis vel obtusis apiculatisque; floribus ignotis; capsula cylindrica 12–15 mm. longa; valvis 3 rigidis 1 mm. crassis oblongo-ellipticis; placenta in parte media 2–4 mm. longa fertili funiculis 2–3 alternatis compressis 2–4 mm. longis gracilibus donata; seminibus 4–5 mm. diametro rubris.

Shrub; branches 2–3 at each forking; branches towards the ends pubescent with short appressed rusty hairs; bark whitish grey; lenticels whitish or brown dot-like specks; leaves usually crowded towards the ends of branches, blades small, elliptic or elliptic-lanceolate, firmly coriaceous, glabrous, deep green above, pale green below, 2–4 cm. long, 1–1.5 cm. wide, the midrib occasionally dividing the blade unequally, apex acute to obtuse and apiculate, margin entire, petioles 0–2 mm. long; flowers not seen; capsules cylindrical, yellowish brown, 12–15 mm. long, surface nearly smooth, fruit-stalk short, thick, 3–4 mm. long, with collar-like arrangement of minute bud-scales persisting at the base; valves usually 3, less than 1 mm. thick, stiff, oblongish elliptic in outline, outer surface yellowish brown, inner surface creamy yellow and inconspicuously striate; funicles 2 or 3 on each valve, alternate on the middle section of the placenta, 2–4 mm. long, slender, flat; seeds large, 5–6 mm. in diameter, roundish, bright red. Known from southernmost Kweichow.

KWEICHOW: Near Anlung, alt. 500 m., in lightwood forests, *Tsiang* 7444 (TYPE, NY) (shrub; leaves lustrous deep green above and light green below; fruits yellow when fresh; seeds red).

In its leaf and capsule, *P. kweichowense* is so distinct that it cannot be referred to any known members of TRIVALVAE in our area. However, in its 3-valved capsules, slender flat funicles, and round red seeds, it somewhat resembles *P. glabratum* and its relatives. It also bears resemblance to some of the members of BIVALVAE. Especially in the shape and size of its capsules it looks somewhat like *P. henryi*. I have included this new species under TRIVALVAE on the basis of the number of valves in the capsule.

Distinctive of the species are the following characters: (a) the cylindrical 3-valved small yellowish capsules; (b) the two or three slender, flat funicles borne on the middle section of each placenta; (c) the large (6 × 5 mm.) seeds; and (d) the small (2–4 cm. long, 1–1.5 cm. wide) elliptic-lanceolate leaves.

5. *Pittosporum rehderianum* sp. nov.

Frutex 1–3 m. alta; foliis oblanceolatis vel obovatis 6–15 cm. longis 2–4.5 cm. latis glabris coriaceis, apice acutis vel acuminatis; inflorescentia pseudoterminali subumbellata glabra; floribus in alabastro 8–10 mm. longis; sepalis inaequalibus 1–2 mm. longis membranaceis glabris late ovatis obtusis vel rotundis; petalis 10–12 mm. longis; ovario glabro; capsulis subglobosis 2 cm. longis lignosis angulatis; valvis 3 late ellipticis 1–2 mm. crassis; placenta basi usque ad apicem fertili funiculis brunneis brevibus rigidis biseriatis donata; seminibus numerosis parvis irregularibus.

Shrub 1–3 m. tall; branching verticillate or forking; bark yellow or brownish grey, speckled with lenticels; leaf-scars conspicuous at the forking of the branches; leaves usually crowded at forking and towards the ends of branches, glabrous, coriaceous, blades occasionally wavy towards the margin, 6–15 cm. long, 2–4.5 cm. wide, oblanceolate or obovate, apex acute to acuminate, margin entire and slightly recurved, petioles 5–15 mm. long; inflorescences pseudo-terminal, subumbellate, glabrous, bracteate at base; bracts and bractlets membranous, whitish brown, very small, oblongish or ovate, 1–4 mm. long, glabrous; pedicels 5–10 mm. long; flower buds oblong, 8–10 mm. long; sepals unequal, 1–2 mm. long, slightly connate at base, membranous, glabrous, broadly ovate, obtuse or rounded, margin thin, whitish; petals yellow, free, 10–12 mm. long; filaments 6–7 mm. long; anthers 2 mm. long; ovary glabrous, 4 mm. long; style glabrous 5 mm. long; stigma slightly capitate; capsules subglobose, 2 cm. long, woody, angulate, 3-valved; fruit-stalk short and stout, 10–20 mm. long; valves broadly elliptic in outline, usually 1–2 mm. thick, woody; funicles peg-like, small, darkish, in two rows, all along the well-marked placental ridge; seeds many, small, irregular, darkish red.

An inland species, known from southern Shensi, Szechwan, and western Hupeh.

SHENSI: Chui-kis-tsuen, Sept. 25, 1897, *Giraldi* (TYPE, A); s. l., *Wilson* 886 (A).

SZECHWAN: Chengtu and vicinity, *Fang* 12144 (A).

HUPEH: Patung Hsien, alt. 1000 m., *Wilson* 3180 (A); s. l., *Wilson* 279a, 583a (A); s. l., *Henry* 3387a, 4369, 5999 (A, GH); Enshih Hsien, *Chow* 1942 (A); Ching-pin-chang, alt. 660 m., *Chun* 3599 (A); Liang-tung-yon, alt. 930 m., *Chun* 3841 (A); Hankow, *Chun* 3773, 3600 (A).

Rehder and Wilson, *Pl. Wils.* 3: 327 (1916), referred some of the cited material to *P. glabratum*. The flower, bract, and bractlet of this species, however, resemble more closely those of *P. lignilobum* and *P. trigonocarpum*. From these it differs in its glabrous ovary and subglobose capsule. Though having the glabrous ovary of *P. glabratum* and *P. glabratum* var. *perüfolium*, it differs from them in its angulate subglobular capsules, in its peg-like funicles, in its glabrous inflorescences, bracts, and bractlets, and in its northern distribution.

6. *Pittosporum trigonocarpum* Lévillé, Fedde Repert. Spec. Nov. 11: 492 (1913). — Type: Kweichow, Tin-Fan, *J. Cavalerie* 1857.

Pittosporum xylocarpum Hu & Wang, Bull. Fan Mem. Inst. Biol. n. ser. 1: 95 (1941). — "Types": Szechwan, Mt. Omei, *W. P. Fang* 13754, 14048.

Pittosporum glabratum sensu Rehder, Jour. Arnold Arb. 12: 280 (1931).

Shrub or small tree, 2–5 m. tall; branching usually verticillate; bark greyish or darkish brown, speckled with lenticels; leaves glabrous, alternate along the branches, becoming loosely verticillate towards the ends, blades occasionally wavy towards the margin, 5–15 cm. long, 2–5 cm. wide, oblanceolate or broadly oblanceolate with acute base, apex acuminate or acute, margin entire, slightly recurved, petioles 5–15 mm. long; inflorescences pseudoterminal, umbellate or subumbellate, glabrous, subtended by a whorl of young leaves and bracts; bracts narrow-lanceolate; flowers fragrant; flower-buds oblong; pedicels 1–2 cm. long, erect, glabrous; sepals ovate, unequal, 2–3 mm. long, obtuse or rounded, glabrous, slightly ciliate; petals yellow, 9–11 mm. long; filaments 6–7 mm. long; anthers sagittate, 2 mm. long; ovary covered with silky whitish brown hairs, obovoid or globular; style glabrous, 3–5 mm. long; stigma pointed; capsules ellipsoid, 3-angled, 15–20 mm. long, 9–10 mm. thick, 3-valved; fruit-stalk 10–25 mm. long, usually erect; valves woody, 1.5–2 mm. thick, elliptic in outline; funicles short, peg-like, biseriate, distributed along the placenta from just above the base to beyond the middle of the placenta, the base and apex of the placenta on the valve infertile; seeds small, many, 3–4 mm. long, darkish red, irregular.

Pittosporum trigonocarpum is widely distributed in China, ranging from Sikong through Szechwan, Hupeh, Kweichow, and Kwangsi to Chekiang. It extends north to southern Shensi. However, it has been most collected in western Szechwan (about Mt. Omei and the adjoining border near Yaan in Sikong) and western Hupeh. Southern Shensi in Central China is the northernmost limit reached by any of our species of *Pittosporum*.

SIKONG: 5 miles from Yaan, near suspension bridge, alt. 600 m., *Chiao* 1151 (A); Moon-ting Shan, alt. 1400 m., *Chiao* 1308 (A).

SZECHWAN: Mt. Omei: alt. 475 m., *Fang* 14048, 14242, 15356 (A); alt. 700–1000 m., *Liu* 2138 (A); *Chiao & Fou* 58 (A); alt. 1000 m., *Wang* 23501 (A); Kuan-hsien, alt. 1000–1200 m., *Fang* 1999 (A); Chen-kou-hsien, *Fang* 9991 (A); Kikiang Hsien, alt. 1200–1500 m., *Fang* 1331 (A); Chung Hsien, *Fang* 469 (A); Mt. Kou-hsien, alt. 600–1300 m., *Liu* 1844 (A); Nanchuan, *Bock v. Rosthorn* 1933, 2074 (A); *Sun & Chang* 600 (A); Taifussu, *Chow* 9035 (A); Wuzussu, *Chow* 9684 (A); Chutze-chang, *Chow* 9425 (A); Hsinchang, *Chow* 9531 (A); north of Chengtu plain, alt. 1200 m., *Wang* 22159 (A); south of Kuan Hsien, alt. 970 m., *Wang* 20486 (A); Ping Shan Hsien, alt. 1800 m., *Wang* 22747 (A); Chengtu, *Chien* 5921 (A); Chien Yang Hsien, *Chien* 5248 (A); Kiating on the hill slope, *Tu* 772 (A); same locality, *Sun & Chang* 16 (A); in forests, alt. 350 m., *Tai* 25 (A); near Kiatingfu, alt. 550 m., *Yü* 185, 187 (A).

HUPEH: Gian Gior Kou, *Chun* 3944 (A); Patung Hsien, alt. 1000 m., *Wilson* 279, 456 (A); Ice fort, *Wilson* 886 (A); s. l., *Wilson* 456 (GH).

KWEICHOW: Tin-fan, *Cavalerie* 1857 (A).

KWANGSI: Tou Ngok Shan, *Tsang* 23149 (A).

CHEKIANG: Sui-an Hsien, alt. 660 m., *Hu* 531 (A).

The differences in capsules and seeds pointed out by Hu & Wang for distinguishing *P. xylocarpum* are those that characterize *P. trigonocarpum*. The species are obviously the same. Hu & Wang have probably overlooked *P. trigonocarpum*.

Pittosporum trigonocarpum is well characterized by its trigonal woody capsules with rough brown or blackish surface, and by its small seeds. It can easily be separated from *P. glabratum* by its hairy ovary. Its closest relative, however, is *P. sahnianum*, with which it intergrades in some characters. The two differ, however, in the size of flowers and capsules and in the length of pedicels, as well as in general appearance.

According to Hu & Wang, the species produces in the spring an abundance of fragrant yellow flowers. These are borne with evergreen foliage at the tips of the branches. Later in the year the abundant oily reddish seeds in the open capsules make an attractive display against the background of glossy bright green leaves.

Pittosporum lignilobum Hu & Wang, Bull. Fan Mem. Inst. Biol. n. ser. 1: 98 (1941). — "Types": Szechwan, Mt. Omei, *Fang* 15503, 15504, and *Sun* 1692.

Small tree or shrub, 2–4 m. tall; branching loosely verticillate or forked; bark grey or brown, speckled with lenticels; leaf-scars broadly reniform; leaves usually crowded towards the ends of branches, blades 9–15 cm. long, 2.5–5 cm. wide, obovate or oblanceolate to elliptic, coriaceous, glabrous, apex acuminate or acute, margin entire, slightly recurved, petioles 1–20 mm. long; inflorescences pseudoterminal, single-flowered or simply umbellate, glabrous; bracts glabrous, membranous, oblong, whitish brown, 1–5 mm. long; pedicels 5–25 mm. long; sepals 2–3 mm. long, glabrous, free or slightly connate at base, oblong-ovate, obtuse, membranous, occasionally ciliate; petals white or yellow, free, 12–14 mm. long; filaments 10 mm. long; anthers 2 mm. long; ovary hairy, 7 mm. long, cylindrical; style glabrous, 5 mm. long; stigma somewhat pointed; capsules ellipsoid, angular, 2–3.5 cm. long, 2 cm. thick, both ends acute or the apex acute and the base abruptly rounded; valves 3–5, usually 4 or 3, woody, 2–3 mm. thick; funicles biseriate, peg-like, reddish brown, 1–2 mm. long, many, distributed all along the well-raised placental ridge; seeds many (up to 46), small, irregular, darkish red.

Known only from Mt. Omei and its vicinity in West Szechwan and perhaps endemic there.

SZECHWAN: Mt. Omei: alt. 650–1760 m., *Fang* 2517, 2598, 3387, 3390, 161, 12651, 15017, 15392, 15503, 15504 (A); *Sun & Chang* 454, 1634, 1731 (A); *Chow* 4871, 7555, 8234, 8484, 8982, 9734 (A); *Lee* 4512, 4531, 4546,

4553 (A); *Tai* 456, 460, 616 (A); *Chiao & Fan* 179, 406 (A); *Liu* 1604, 1720, 1822 (A); Uo-mi-san (Mt. Omei), 1899, *Fr. Hugh s. n.* (A); O-Pien-Hsien, alt. 1300-1800 m., *Liu* 2167 (A).

Pittosporum lignilobum is noteworthy for its very large capsules. In maximum size, they are the largest developed by any of our species. The valves may become very thick, and may occur in number as high as five. No other Asiatic species has such coarse valves or produces then in such high numbers. Even the number of seeds produced (as high as 46) is greater than in other species in our area.

This is an interesting species. I have seen few flowering specimens. My description of the inflorescence and flower is based on *Chow* 9734, and supplemented from the original description. The species probably has dimorphic flowers, since this condition prevails in related species having capsules that are invariably solitary. Those who may have an opportunity to collect the plant should note floral dimorphism, if any.

8. *Pittosporum subulisepalum* Hu & Wang, Bull. Fan Mem. Inst. Biol. n. ser. 1: 100 (1941).—“Types,” Hunan, without precise locality, *T. H. Chao* [*Chao*] 610, 5000.

Leaves oblong-obovate, rarely obovate to oblong-elliptic, 4-11 cm. long, 1.5-4 cm. wide, apex acuminate to acute; inflorescences pseudoterminal, few-flowered (2-4 flowers), umbellate, glabrous; pedicels 6-10 mm. long; sepals free, linear-lanceolate, acuminate, 7 mm. long, ciliate; petals narrow, oblong, obtuse, 8.5-9 mm. long; filaments 2.5 mm. long; anthers sagittate, obtuse, 1.3 mm. long; ovary densely hairy, 3-carpelled, obovoid; ovules 16, 5 or 6 on each placenta; capsules ovoid, 3-valved; valves woody, 12 mm. long, 8 mm. wide.

Known from Hunan and Anhwei.

The short description given above has been adapted from the original of Hu & Wang. I have seen no plant recognizable as belonging to this species. According to Hu & Wang, its outstanding character is its long sepals. The latter are said to be linear-lanceolate and 7 mm. long. Such elongate sepals are really unique among the members of the TRIVALVAE. Of all the members of this group which I have examined, none have sepals longer than 4-5 mm. The long sepals combined with roundish ovoid 3-valved capsules are indeed distinctive features.

9. *Pittosporum crispulum* Gagnepain, Bull. Soc. Bot. France 55: 546 (1908).—Type: “Chine. — Yunnan: Ko-kouy, près Tchao-tong; plante cueillie par le P. Marc Mey, avril 1896, no. 4720 (*Ducloux*).”

Shrub 1-3 m. tall; branching verticillate or forking; bark on old branches brownish grey, speckled with lenticels, on young branches darkish brown without evident lenticels; leaves alternate along and loosely crowded towards the ends of the branches, blades 6-12 cm. long, 2-5 cm. wide, oblanceolate or obovate, broader at or above the middle, tapering towards base, coriaceous, glabrous, upper surface darkish brown, lower surface

light brown, apex acute, margin entire, slightly recurved, petioles 5–20 mm. long; inflorescences pseudoterminal, umbellate or subumbellate or single-flowered, pubescent with darkish or brown silky hairs or glabrous, subtended at base with bracts and leaves; pedicels equalling or slightly longer than subtending petioles; bracts narrowly lanceolate, glabrous; bractlets minute, inconspicuous, linear, 2–3 mm. long, slightly pubescent or glabrous; flowers polygamo-dioecious (*Tsai* 55741); sepals free or connate at base, glabrous or pubescent, 2–3 mm. long, ovate or lanceolate, acute, ciliate; petals yellow, 12–15 mm. long. Short-stamened flowers: solitary; filaments 5 mm. long, not surpassing the body of the ovary; anthers 1.5 mm. long, sagittiform, poorly developed; ovary 3-carpelled, ovoid, hairy, 6–7 mm. long; style glabrous, 5 mm. long; stigma capitate. Long-stamened flowers: umbellate or subumbellate; filaments 7–8 mm. long; anthers 2 mm. long, oblong, level with stigma; ovary cylindrical, hairy, 3-carpelled, 6 mm. long; style glabrous, 5 mm. long; stigma pointed. Capsules not seen.

Known from the upper Salween River Valley in western Yunnan.

YUNNAN: Lung-Ling Hsien, alt. 1800 m., *Tsai* 55741 (A) (two twigs on the sheet, one with subumbellate inflorescence in which the flowers bear long stamens; the other single-flowered with the flowers bearing short stamens), and *Tsai* 55602, 55697 (A); Yan Tsien Hsien, alt. 500 m., *Tsai* 55806 (A); s. l., *Forrest* 9856 (A) (this is densely tomentose and has larger flowers).

Distinctive of the species are its large flowers, usually 12–15 mm. long, and its limited distribution in the Salween River Valley in western Yunnan. Unfortunately neither Gagnepain nor I have seen fruits of any specimen referable to this species. Until these are known, the species must remain doubtful, since flower-size is not a very reliable character among the species with dimorphic flowers.

(*To be concluded*)

RECENT PUBLICATIONS OF THE
ARNOLD ARBORETUM

- JOHNSTON, I. M. **The Botany of San Jose Island (Gulf of Panama).** Sargentia VIII. Pp. 1-306, with seventeen plates and two text-figures. April 22, 1949 \$6.0
- REHDER, ALFRED. **Bibliography of Cultivated Trees and Shrubs.** Pp. i-xl, 1-825. 4° June 14, 1949. . . . \$20.0
- MERRILL, ELMER D. **Index Rafinesquianus.** Pp. i-vi, 1-296. 4°. August 8, 1949. \$10.0

Make checks payable to the ARNOLD ARBORETUM.